

THE MONIST.

THE ARCHITECTURE OF THEORIES. ~~XIII~~

OF the fifty or hundred systems of philosophy that have been advanced at different times of the world's history, perhaps the larger number have been, not so much results of historical evolution, as happy thoughts which have accidentally occurred to their authors. An idea which has been found interesting and fruitful has been adopted, developed, and forced to yield explanations of all sorts of phenomena. The English have been particularly given to this way of philosophising; witness, Hobbes, Hartley, Berkeley, James Mill. Nor has it been by any means useless labor; it shows us what the true nature and value of the ideas developed are, and in that way affords serviceable materials for philosophy. Just as if a man, being seized with the conviction that paper was a good material to make things of, were to go to work to build a *papier mâché* house, with roof of roofing-paper, foundations of paste-board, windows of paraffined paper, chimneys, bath tubs, locks, etc., all of different forms of paper, his experiment would probably afford valuable lessons to builders, while it would certainly make a detestable house, so those one-idea'd philosophies are exceedingly interesting and instructive, and yet are quite unsound.

The remaining systems of philosophy have been of the nature of reforms, sometimes amounting to radical revolutions, suggested by certain difficulties which have been found to beset systems previously in vogue; and such ought certainly to be in large part the motive of any new theory. This is like partially rebuilding a house.

The faults that have been committed are, first, that the dilapidations have generally not been sufficiently thoroughgoing, and second, that not sufficient pains has been taken to bring the additions into deep harmony with the really sound parts of the old structure.

When a man is about to build a house, what a power of thinking he has to do, before he can safely break ground! With what pains he has to excogitate the precise wants that are to be supplied! What a study to ascertain the most available and suitable materials, to determine the mode of construction to which those materials are best adapted, and to answer a hundred such questions! Now without riding the metaphor too far, I think we may safely say that the studies preliminary to the construction of a great theory should be at least as deliberate and thorough as those that are preliminary to the building of a dwelling-house.

That systems ought to be constructed architectonically has been preached since Kant, but I do not think the full import of the maxim has by any means been apprehended. What I would recommend is that every person who wishes to form an opinion concerning fundamental problems, should first of all make a complete survey of human knowledge, should take note of all the valuable ideas in each branch of science, should observe in just what respect each has been successful and where it has failed, in order that in the light of the thorough acquaintance so attained of the available materials for a philosophical theory and of the nature and strength of each, he may proceed to the study of what the problem of philosophy consists in, and of the proper way of solving it. I must not be understood as endeavoring to state fully all that these preparatory studies should embrace; on the contrary, I purposely slur over many points, in order to give emphasis to one special recommendation, namely, to make a systematic study of the conceptions out of which a philosophical theory may be built, in order to ascertain what place each conception may fitly occupy in such a theory, and to what uses it is adapted.

The adequate treatment of this single point would fill a volume, but I shall endeavor to illustrate my meaning by glancing at several sciences and indicating conceptions in them serviceable for philos-

ophy. As to the results to which long studies thus commenced have led me, I shall just give a hint at their nature.

We may begin with dynamics,—field in our day of perhaps the grandest conquest human science has ever made,—I mean the law of the conservation of energy. But let us revert to the first step taken by modern scientific thought,—and a great stride it was,—the inauguration of dynamics by Galileo. A modern physicist on examining Galileo's works is surprised to find how little experiment had to do with the establishment of the foundations of mechanics. His principal appeal is to common sense and *il lume naturale*. He always assumes that the true theory will be found to be a simple and natural one. And we can see why it should indeed be so in dynamics. For instance, a body left to its own inertia, moves in a straight line, and a straight line appears to us the simplest of curves. In *itself*, no curve is simpler than another. A system of straight lines has intersections precisely corresponding to those of a system of like parabolas similarly placed, or to those of any one of an infinity of systems of curves. But the straight line appears to us simple, because, as Euclid says, it lies evenly between its extremities; that is, because viewed endwise it appears as a point. That is, again, because light moves in straight lines. Now, light moves in straight lines because of the part which the straight line plays in the laws of dynamics. Thus it is that our minds having been formed under the influence of phenomena governed by the laws of mechanics, certain conceptions entering into those laws become implanted in our minds, so that we readily guess at what the laws are. Without such a natural prompting, having to search blindfold for a law which would suit the phenomena, our chance of finding it would be as one to infinity. The further physical studies depart from phenomena which have directly influenced the growth of the mind, the less we can expect to find the laws which govern them “simple,” that is, composed of a few conceptions natural to our minds.

The researches of Galileo, followed up by Huygens and others, led to those modern conceptions of *Force* and *Law*, which have revolutionised the intellectual world. The great attention given to

mechanics in the seventeenth century soon so emphasised these conceptions as to give rise to the Mechanical Philosophy, or doctrine that all the phenomena of the physical universe are to be explained upon mechanical principles. Newton's great discovery imparted a new impetus to this tendency. The old notion that heat consists in an agitation of corpuscles was now applied to the explanation of the chief properties of gases. The first suggestion in this direction was that the pressure of gases is explained by the battering of the particles against the walls of the containing vessel, which explained Boyle's law of the compressibility of air. Later, the expansion of gases, Avogadro's chemical law, the diffusion and viscosity of gases, and the action of Crookes's radiometer were shown to be consequences of the same kinetical theory; but other phenomena, such as the ratio of the specific heat at constant volume to that at constant pressure require additional hypotheses, which we have little reason to suppose are simple, so that we find ourselves quite afloat. In like manner with regard to light, that it consists of vibrations was almost proved by the phenomena of diffraction, while those of polarisation showed the excursions of the particles to be perpendicular to the line of propagation; but the phenomena of dispersion, etc., require additional hypotheses which may be very complicated. Thus, the further progress of molecular speculation appears quite uncertain. If hypotheses are to be tried haphazard, or simply because they will suit certain phenomena, it will occupy the mathematical physicists of the world say half a century on the average to bring each theory to the test, and since the number of possible theories may go up into the trillions, only one of which can be true, we have little prospect of making further solid additions to the subject in our time. When we come to atoms, the presumption in favor of a simple law seems very slender. There is room for serious doubt whether the fundamental laws of mechanics hold good for single atoms, and it seems quite likely that they are capable of motion in more than three dimensions.

To find out much more about molecules and atoms, we must search out a natural history of laws of nature, which may fulfil that function which the presumption in favor of simple laws fulfilled in

the early days of dynamics, by showing us what kind of laws we have to expect and by answering such questions as this: Can we with reasonable prospect of not wasting time, try the supposition that atoms attract one another inversely as the seventh power of their distances, or can we not? To suppose universal laws of nature capable of being apprehended by the mind and yet having no reason for their special forms, but standing inexplicable and irrational, is hardly a justifiable position. Uniformities are precisely the sort of facts that need to be accounted for. That a pitched coin should sometimes turn up heads and sometimes tails calls for no particular explanation; but if it shows heads every time, we wish to know how this result has been brought about. Law is *par excellence* the thing that wants a reason.

Now the only possible way of accounting for the laws of nature and for uniformity in general is to suppose them results of evolution. This supposes them not to be absolute, not to be obeyed precisely. It makes an element of indeterminacy, spontaneity, or absolute chance in nature. Just as, when we attempt to verify any physical law, we find our observations cannot be precisely satisfied by it, and rightly attribute the discrepancy to errors of observation, so we must suppose far more minute discrepancies to exist owing to the imperfect cogency of the law itself, to a certain swerving of the facts from any definite formula.

Mr. Herbert Spencer wishes to explain evolution upon mechanical principles. This is illogical, for four reasons. First, because the principle of evolution requires no extraneous cause; since the tendency to growth can be supposed itself to have grown from an infinitesimal germ accidentally started. Second, because law ought more than anything else to be supposed a result of evolution. Third, because exact law obviously never can produce heterogeneity out of homogeneity; and arbitrary heterogeneity is the feature of the universe the most manifest and characteristic. Fourth, because the law of the conservation of energy is equivalent to the proposition that all operations governed by mechanical laws are reversible; so that an immediate corollary from it is that growth is not explicable by those laws, even if they be not violated in the process of growth.

In short, Spencer is not a philosophical evolutionist, but only a half-evolutionist,—or, if you will, only a semi-Spencerian. Now philosophy requires thoroughgoing evolutionism or none.

The theory of Darwin was that evolution had been brought about by the action of two factors: first, heredity, as a principle making offspring nearly resemble their parents, while yet giving room for "sporting," or accidental variations,—for very slight variations often, for wider ones rarely; and, second, the destruction of breeds or races that are unable to keep the birth rate up to the death rate. This Darwinian principle is plainly capable of great generalisation. Wherever there are large numbers of objects, having a tendency to retain certain characters unaltered, this tendency, however, not being absolute but giving room for chance variations, then, if the amount of variation is absolutely limited in certain directions by the destruction of everything which reaches those limits, there will be a gradual tendency to change in directions of departure from them. Thus, if a million players sit down to bet at an even game, since one after another will get ruined, the average wealth of those who remain will perpetually increase. Here is indubitably a genuine formula of possible evolution, whether its operation accounts for much or little in the development of animal and vegetable species.

The Lamarckian theory also supposes that the development of species has taken place by a long series of insensible changes, but it supposes that those changes have taken place during the lives of the individuals, in consequence of effort and exercise, and that reproduction plays no part in the process except in preserving these modifications. Thus, the Lamarckian theory only explains the development of characters for which individuals strive, while the Darwinian theory only explains the production of characters really beneficial to the race, though these may be fatal to individuals.* But more broadly and philosophically conceived, Darwinian evolution is evolution by the operation of chance, and the destruction of

* The neo-Darwinian, Weismann, has shown that mortality would almost necessarily result from the action of the Darwinian principle.

bad results, while Lamarckian evolution is evolution by the effect of habit and effort.

A third theory of evolution is that of Mr. Clarence King. The testimony of monuments and of rocks is that species are unmodified or scarcely modified, under ordinary circumstances, but are rapidly altered after cataclysms or rapid geological changes. Under novel circumstances, we often see animals and plants sporting excessively in reproduction, and sometimes even undergoing transformations during individual life, phenomena no doubt due partly to the enfeeblement of vitality from the breaking up of habitual modes of life, partly to changed food, partly to direct specific influence of the element in which the organism is immersed. If evolution has been brought about in this way, not only have its single steps not been insensible, as both Darwinians and Lamarckians suppose, but they are furthermore neither haphazard on the one hand, nor yet determined by an inward striving on the other, but on the contrary are effects of the changed environment, and have a positive general tendency to adapt the organism to that environment, since variation will particularly affect organs at once enfeebled and stimulated. This mode of evolution, by external forces and the breaking up of habits, seems to be called for by some of the broadest and most important facts of biology and paleontology; while it certainly has been the chief factor in the historical evolution of institutions as in that of ideas; and cannot possibly be refused a very prominent place in the process of evolution of the universe in general.

Passing to psychology, we find the elementary phenomena of mind fall into three categories. First, we have Feelings, comprising all that is immediately present, such as pain, blue, cheerfulness, the feeling that arises when we contemplate a consistent theory, etc. A feeling is a state of mind having its own living quality, independent of any other state of mind. Or, a feeling is an element of consciousness which might conceivably override every other state until it monopolised the mind, although such a rudimentary state cannot actually be realised, and would not properly be consciousness. Still, it is conceivable, or supposable, that the quality of

blue should usurp the whole mind, to the exclusion of the ideas of shape, extension, contrast, commencement and cessation, and all other ideas, whatsoever. A feeling is necessarily perfectly simple, *in itself*, for if it had parts these would also be in the mind, whenever the whole was present, and thus the whole could not monopolise the mind.*

Besides Feelings, we have Sensations of reaction; as when a person blindfold suddenly runs against a post, when we make a muscular effort, or when any feeling gives way to a new feeling. Suppose I had nothing in my mind but a feeling of blue, which were suddenly to give place to a feeling of red; then, at the instant of transition there would be a shock, a sense of reaction, my blue life being transmuted into red life. If I were further endowed with a memory, that sense would continue for some time, and there would also be a peculiar feeling or sentiment connected with it. This last feeling might endure (conceivably I mean) after the memory of the occurrence and the feelings of blue and red had passed away. But the *sensation* of reaction cannot exist except in the actual presence of the two feelings blue and red to which it relates. Wherever we have two feelings and pay attention to a relation between them of whatever kind, there is the sensation of which I am speaking. But the sense of action and reaction has two types: it may either be a perception of relation between two ideas, or it may be a sense of action and reaction between feeling and something out of feeling. And this sense of external reaction again has two forms; for it is either a sense of something happening to us, by no act of ours, we being passive in the matter, or it is a sense of resistance, that is, of our expending feeling upon something without. The sense of reaction is thus a sense of connection or comparison between feelings, either, *A*, between one feeling and another, or *B*, between feeling and its absence or lower degree; and under *B* we have, First, the sense of the access of feeling, and Second, the sense of remission of feeling.

* A feeling may certainly be compound, but only in virtue of a perception which is not that feeling nor any feeling at all.

Very different both from feelings and from reaction-sensations or disturbances of feeling are general conceptions. When we think, we are conscious that a connection between feelings is determined by a general rule, we are aware of being governed by a habit. Intellectual power is nothing but facility in taking habits and in following them in cases essentially analogous to, but in non-essentials widely remote from, the normal cases of connections of feelings under which those habits were formed.

The one primary and fundamental law of mental action consists in a tendency to generalisation. Feeling tends to spread ; connections between feelings awaken feelings ; neighboring feelings become assimilated ; ideas are apt to reproduce themselves. These are so many formulations of the one law of the growth of mind. When a disturbance of feeling takes place, we have a consciousness of gain, the gain of experience ; and a new disturbance will be apt to assimilate itself to the one that preceded it. Feelings, by being excited, become more easily excited, especially in the ways in which they have previously been excited. The consciousness of such a habit constitutes a general conception.

The cloudiness of psychological notions may be corrected by connecting them with physiological conceptions. Feeling may be supposed to exist, wherever a nerve-cell is in an excited condition. The disturbance of feeling, or sense of reaction, accompanies the transmission of disturbance between nerve-cells or from a nerve-cell to a muscle-cell or the external stimulation of a nerve-cell. General conceptions arise upon the formation of habits in the nerve-matter, which are molecular changes consequent upon its activity and probably connected with its nutrition.

The law of habit exhibits a striking contrast to all physical laws in the character of its commands. A physical law is absolute. What it requires is an exact relation. Thus, a physical force introduces into a motion a component motion to be combined with the rest by the parallelogram of forces ; but the component motion must actually take place exactly as required by the law of force. On the other hand, no exact conformity is required by the mental law. Nay, exact conformity would be in downright conflict with the law ; since

it would instantly crystallise thought and prevent all further formation of habit. The law of mind only makes a given feeling *more likely* to arise. It thus resembles the "non-conservative" forces of physics, such as viscosity and the like, which are due to statistical uniformities in the chance encounters of trillions of molecules.

The old dualistic notion of mind and matter, so prominent in Cartesianism, as two radically different kinds of substance, will hardly find defenders to-day. Rejecting this, we are driven to some form of hylopathy, otherwise called monism. Then the question arises whether physical laws on the one hand, and the psychical law on the other are to be taken—

(A) as independent, a doctrine often called *monism*, but which I would name *neutralism*; or,

(B) the psychical law as derived and special, the physical law alone as primordial, which is *materialism*; or,

(C) the physical law as derived and special, the psychical law alone as primordial, which is *idealism*.

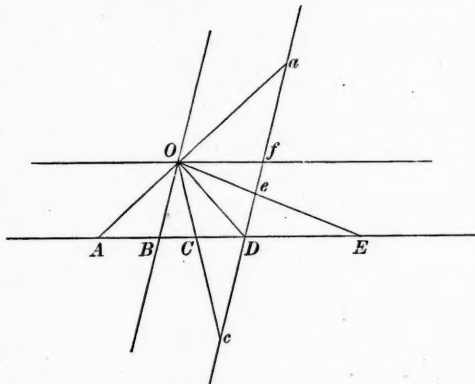
The materialistic doctrine seems to me quite as repugnant to scientific logic as to common sense; since it requires us to suppose that a certain kind of mechanism will feel, which would be a hypothesis absolutely irreducible to reason,—an ultimate, inexplicable regularity; while the only possible justification of any theory is that it should make things clear and reasonable.

Neutralism is sufficiently condemned by the logical maxim known as Ockham's razor, i. e., that not more independent elements are to be supposed than necessary. By placing the inward and outward aspects of substance on a par, it seems to render both primordial.

The one intelligible theory of the universe is that of objective idealism, that matter is effete mind, inveterate habits becoming physical laws. But before this can be accepted it must show itself capable of explaining the tridimensionality of space, the laws of motion, and the general characteristics of the universe, with mathematical clearness and precision; for no less should be demanded of every Philosophy.

Modern mathematics is replete with ideas which may be ap-

plied to philosophy. I can only notice one or two. The manner in which mathematicians generalise is very instructive. Thus, painters are accustomed to think of a picture as consisting geometrically of the intersections of its plane by rays of light from the natural objects to the eye. But geometers use a generalised perspective. For instance, in the figure let O be the eye, let $A B C D E$ be the edgewise view of any plane, and let $a f e D c$ be the edgewise view of another plane. The geometers draw rays through O cutting both these planes, and treat the points of intersection of each ray with one plane as representing the point of intersection of the same ray with the other plane. Thus, e represents E , in the painter's way. D represents itself. C is represented by c , which is further from



the eye; and A is represented by a which is on the other side of the eye. Such generalisation is not bound down to sensuous images. Further, according to this mode of representation every point on one plane represents a point on the other, and every point on the latter is represented by a point on the former. But how about the point f which is in a direction from O parallel to the represented plane, and how about the point B which is in a direction parallel to the representing plane? Some will say that these are exceptions; but modern mathematics does not allow exceptions which can be annulled by generalisation. As a point moves from C to D and thence to E and off toward infinity, the corresponding point on the other plane moves from c to D and thence to e and toward f . But this second point can pass through f to a ; and when it is there the first point has arrived at A . We therefore say that the first point has passed *through infinity*, and that every line joins in to itself somewhat like an oval. Geometers

talk of the parts of lines at an infinite distance as points. This is a kind of generalisation very efficient in mathematics.

Modern views of measurement have a philosophical aspect. There is an indefinite number of systems of measuring along a line; thus, a perspective representation of a scale on one line may be taken to measure another, although of course such measurements will not agree with what we call the distances of points on the latter line. To establish a system of measurement on a line we must assign a distinct number to each point of it, and for this purpose we shall plainly have to suppose the numbers carried out into an infinite number of places of decimals. These numbers must be ranged along the line in unbroken sequence. Further, in order that such a scale of numbers should be of any use, it must be capable of being shifted into new positions, each number continuing to be attached to a single distinct point. Now it is found that if this is true for "imaginary" as well as for real points (an expression which I cannot stop to elucidate), any such shifting will necessarily leave two numbers attached to the same points as before. So that when the scale is moved over the line by any continuous series of shiftings of one kind, there are two points which no numbers on the scale can ever reach, except the numbers fixed there. This pair of points, thus unattainable in measurement, is called the Absolute. These two points may be distinct and real, or they may coincide, or they may be both imaginary. As an example of a linear quantity with a double absolute we may take probability, which ranges from an unattainable absolute certainty *against* a proposition to an equally unattainable absolute certainty *for* it. A line, according to ordinary notions, we have seen is a linear quantity where the two points at infinity coincide. A velocity is another example. A train going with infinite velocity from Chicago to New York would be at all the points on the line at the very same instant, and if the time of transit were reduced to less than nothing it would be moving in the other direction. An angle is a familiar example of a mode of magnitude with no real immeasurable values. One of the questions philosophy has to consider is whether the development of the universe is like the increase of an angle, so that it proceeds forever

without tending toward anything unattained, which I take to be the Epicurean view, or whether the universe sprang from a chaos in the infinitely distant past to tend toward something different in the infinitely distant future, or whether the universe sprang from nothing in the past to go on indefinitely toward a point in the infinitely distant future, which, were it attained, would be the mere nothing from which it set out.

The doctrine of the absolute applied to space comes to this, that either—

First, space is, as Euclid teaches, both *unlimited* and *immeasurable*, so that the infinitely distant parts of any plane seen in perspective appear as a straight line, in which case the sum of the three angles of a triangle amounts to 180° ; or,

Second, space is *immeasurable* but *limited*, so that the infinitely distant parts of any plane seen in perspective appear as a circle, beyond which all is blackness, and in this case the sum of the three angles of a triangle is less than 180° by an amount proportional to the area of the triangle; or,

Third, space is *unlimited* but *finite*, (like the surface of a sphere,) so that it has no infinitely distant parts; but a finite journey along any straight line would bring one back to his original position, and looking off with an unobstructed view one would see the back of his own head enormously magnified, in which case the sum of the three angles of a triangle exceeds 180° by an amount proportional to the area.

Which of these three hypotheses is true we know not. The largest triangles we can measure are such as have the earth's orbit for base, and the distance of a fixed star for altitude. The angular magnitude resulting from subtracting the sum of the two angles at the base of such a triangle from 180° is called the star's *parallax*. The parallaxes of only about forty stars have been measured as yet. Two of them come out negative, that of Arided (α Cyni), a star of magnitude $1\frac{1}{2}$, which is $-0.''082$, according to C. A. F. Peters, and that of a star of magnitude $7\frac{3}{4}$, known as Piazzi III 422, which is $-0.''045$ according to R. S. Ball. But these negative parallaxes are undoubtedly to be attributed to errors of observation; for the

probable error of such a determination is about ± 0.0075 , and it would be strange indeed if we were to be able to see, as it were, more than half way round space, without being able to see stars with larger negative parallaxes. Indeed, the very fact that of all the parallaxes measured only two come out negative would be a strong argument that the smallest parallaxes really amount to $+0.01$, were it not for the reflexion that the publication of other negative parallaxes may have been suppressed. I think we may feel confident that the parallax of the furthest star lies somewhere between -0.005 and $+0.015$, and within another century our grandchildren will surely know whether the three angles of a triangle are greater or less than 180° ,—that they are *exactly* that amount is what nobody ever can be justified in concluding. It is true that according to the axioms of geometry the sum of the three sides of a triangle are precisely 180° ; but these axioms are now exploded, and geometers confess that they, as geometers, know not the slightest reason for supposing them to be precisely true. They are expressions of our inborn conception of space, and as such are entitled to credit, so far as their truth could have influenced the formation of the mind. But that affords not the slightest reason for supposing them exact.

Now, metaphysics has always been the ape of mathematics. Geometry suggested the idea of a demonstrative system of absolutely certain philosophical principles; and the ideas of the metaphysicians have at all times been in large part drawn from mathematics. The metaphysical axioms are imitations of the geometrical axioms; and now that the latter have been thrown overboard, without doubt the former will be sent after them. It is evident, for instance, that we can have no reason to think that every phenomenon in all its minutest details is precisely determined by law. That there is an arbitrary element in the universe we see,—namely, its variety. This variety must be attributed to spontaneity in some form.

Had I more space, I now ought to show how important for philosophy is the mathematical conception of continuity. Most of what is true in Hegel is a darkling glimmer of a conception

which the mathematicians had long before made pretty clear, and which recent researches have still further illustrated.

Among the many principles of Logic which find their application in Philosophy, I can here only mention one. Three conceptions are perpetually turning up at every point in every theory of logic, and in the most rounded systems they occur in connection with one another. They are conceptions so very broad and consequently indefinite that they are hard to seize and may be easily overlooked. I call them the conceptions of First, Second, Third. First is the conception of being or existing independent of anything else. Second is the conception of being relative to, the conception of reaction with, something else. Third is the conception of mediation, whereby a first and second are brought into relation. To illustrate these ideas, I will show how they enter into those we have been considering. The origin of things, considered not as leading to anything, but in itself, contains the idea of First, the end of things that of Second, the process mediating between them that of Third. A philosophy which emphasises the idea of the One, is generally a dualistic philosophy in which the conception of Second receives exaggerated attention; for this One (though of course involving the idea of First) is always the other of a manifold which is not one. The idea of the Many, because variety is arbitrariness and arbitrariness is repudiation of any Secondness, has for its principal component the conception of First. In psychology Feeling is First, Sense of reaction Second, General conception Third, or mediation. In biology, the idea of arbitrary sporting is First, heredity is Second, the process whereby the accidental characters become fixed is Third. Chance is First, Law is Second, the tendency to take habits is Third. Mind is First, Matter is Second, Evolution is Third.

Such are the materials out of which chiefly a philosophical theory ought to be built, in order to represent the state of knowledge to which the nineteenth century has brought us. Without going into other important questions of philosophical architectonic, we can readily foresee what sort of a metaphysics would appropriately be constructed from those conceptions. Like some of the most ancient and some of the most recent speculations it would be a Cosmogonic

Philosophy. It would suppose that in the beginning,—infinitely remote,—there was a chaos of unpersonalised feeling, which being without connection or regularity would properly be without existence. This feeling, sporting here and there in pure arbitrariness, would have started the germ of a generalising tendency. Its other sportings would be evanescent, but this would have a growing virtue. Thus, the tendency to habit would be started; and from this with the other principles of evolution all the regularities of the universe would be evolved. At any time, however, an element of pure chance survives and will remain until the world becomes an absolutely perfect, rational, and symmetrical system, in which mind is at last crystallised in the infinitely distant future.

That idea has been worked out by me with elaboration. It accounts for the main features of the universe as we know it,—the characters of time, space, matter, force, gravitation, electricity, etc. It predicts many more things which new observations can alone bring to the test. May some future student go over this ground again, and have the leisure to give his results to the world.

CHARLES S. PEIRCE.

ILLUSTRATIVE STUDIES IN CRIMINAL ANTHROPOLOGY.

I.

"LA BÊTE HUMAINE" AND CRIMINAL ANTHROPOLOGY.

IF I had to be the judge of M. Zola I could be only a very partial judge. To me the books of Zola are, with those of Dostoyewski and Tolstoï, the only ones which have struck a fresh tone in the literary monotony of this quarter of a century, in which it is said the political levelling and the general abasement of character extend even to the republic of letters. Thus I am partial to Zola, for, as the chief of a school which pushes the science of psychiatry far into the field of psychology and of sociology, I find in Zola an ally the more valuable that he has not been sought and that he reigns in a very different empire. To the scientific charlatans who deny, as does M. Colajanni, the importance and the gravity of alcoholism, its associations with crime and degeneracy, "*L'Assommoir*" is perhaps the best of refutations. "*Germinal*" and "*La Fortune des Rougon*" give us the demonstration of that cruelty which is born for the crowd and in the crowd, and both prove the influence that criminals and lunatics have in rebellions. Zola is the only one of the Latin race who endeavors to introduce the scientific method into literary work.

His romances are modern histories which are founded upon living data, as histories in general are on dead data. And in history he knows also how to employ soberness, by contenting himself with a very simple sketch, disdaining the vulgar tricks which are as easy to invent as they are far from the truth.

I ought to be still more partial to "*La Bête Humaine*"; for, with a generosity not very frequent in men of letters, M. Zola avows that he had recourse to my "*Homme Criminel*" and my "*Homme de Génie*" for the material for his romance. Nevertheless, I cannot forbear mixing some criticism with the praises merited by this work, for I do not find satisfied by it that which I regard more than my personal vanity: my love of truth. In "*La Bête Humaine*" all those artifices which the romanticists had accustomed us to, and from which Zola was freed, reappear, and that alas too often!

In the first place, it is a sufficiently strange fatality that the same knife that was given as a mark of conjugal love should be by turns the instrument of every murder committed, and that all the assassinations, derailments, and suicides invariably occur at the Croix-de-Maufra, where the first lewd practices of the President Grandmorin took place. That a great number of criminals should be congregated in the small enclosure of a second-rate railway station and of its approaches, is in itself a strange fact, but it is still more strange that every crime always derives its character from that accursed place which already bears a fateful and dismal name. This is contrary to the laws of probability; for we know by statistics that the number of criminals, as well as of crimes, is always the same for a certain number of people, or a certain number of square miles, or years, and cannot be massed and restricted to a small space of ground, to so few individuals, and so short a time. This is an atavistic reversion, or, we might say, a return to the old ways of romance, in which fatal events always followed each other in certain fatal localities, or through particular men and by certain fated weapons, etc. In "*La Fortune des Rougon*," also, there is a certain musket which serves for the murder of gendarmes by a grandfather and his nephew, and of the nephew by gendarmes; as if the cause of the fatality was not the hereditary instinct, but this silent and unconscious instrument.

However, the greatest fault is not here; but rather in the delineation of character. Zola, who, in my opinion, has admirably depicted people poisoned by alcohol, and the common middle classes of the towns and of the country, has not studied criminals accord-

ing to nature: undoubtedly because the latter are not so easily met with; nor allow themselves to be studied even in prisons. Zola's figures of criminals give me the false pictorial effect produced by certain photographs taken from portraits, and not from the living subjects. For this reason it is then that I, who have studied thousands and thousands of criminals, should not know how to class his Roubaud, a good clerk and a good husband, who on accidentally discovering the secret of the old amours of his wife with Grandmorin, which were not yet done with, throws himself upon her, wishes to kill her, finally changes his mind, and ends by deciding on the murder of the pseudo-adulterer, with the complicity of his wife. Can he be called a criminal through passion? But then it is *she* that he should have killed, or at least the adulterer being killed he should have repented of it. And again, criminals through passion are, like Roubaud, very good and respectable people, but in their crimes they rush blindly and headlong forward, without accomplices, without premeditation, and without artifices. And they repent, they confess: they are the only criminals who feel remorse. He has no remorse; for some time he leads a life of revenge, and, afterwards, suddenly, he gives himself up to vice, to wine, to gambling, and forgets his wife, and he is jealous of her no more; on the contrary, indifferent, he assists in her infidelities. Can he be called a born criminal, a *bête*? But then how explain that he had lived so long without vices, free from debauchery, and that he had been so good a clerk? He could still be a criminal incidentally; but for a correct, steady, quiet man, as a railway official ought to be, would the discovery of the old amour of his wife be a proportionate reason for him to commit a premeditated murder, the greatest of crimes? And then, as we shall see, criminaloids are born criminals in part; they have many of the latter's psychological and physical characteristics. Now Roubaud has a full beard, red hair, and quick eyes: the only anomalies are meeting eyebrows, a low forehead, and a flat head: nothing is said of hysterical or epileptical ancestors.

According to Henry Héricourt (*Revue Bleue*, p. 14), M. Zola was inspired by a recent trial, that of the apothecary Fenayron, who is said to have had much resemblance to Roubaud. Marin

Fenayron, the apothecary, was a man of forty-one, intelligent, steady, and industrious. He had married, twelve years before, the youngest daughter of his old employer, whom he had succeeded. His wife, who was eighteen years old at the time of her marriage, and who had consented to the union only with repugnance, was not slow to deceive him, and soon formed an intimacy with his assistant. This triangular relation lasted a time, not precisely stated by the proceedings, but sufficiently long for Gabrielle Fenayron, tired of her first lover, to take the opportunity to replace him by several others. The husband, who during this time has become a gambler and idle fellow, is informed of the misconduct of his wife. Although he did not put much credit in this at first, yet in the quarrels which followed and were continually renewed he ended by abusing her, striking her, and menacing her with death: and at last he obtained from her the confession of her relations with his old assistant Aubert, then himself established as a chemist. According to her recital, the woman could obtain the pardon of her husband only by the promise that she would assist him in his plans of revenge, and she had consented through shame without protesting. Then, by the order of her husband, she writes several letters to her old lover, renews relations with him, and finally, under the pretext of a country excursion, draws him into an ambush where she aided her husband in killing him with a hammer. It will be remembered that Aubert, after the first blow, turned round, recognised his murderer, and prepared to defend himself: but his mistress threw herself on him, twined her arms about him, and the husband could thus finish his work in safety.

After the crime there was no remorse on the part of either the one or the other. Far to the contrary. The criminal pair delivered themselves anew to their accustomed distractions with the most perfect tranquillity, and the performance appeared without doubt very natural to Fenayron, for one day, meeting his mother-in-law, he accosted her, saying, "Well, Mother, it is done. I have killed Aubert."

But let it be remarked how this Marin Fenayron, who figures as an occasional criminal, this time reveals himself a criminal by habit, meditating and premeditating his vengeance, waiting two

long months before putting it into execution, surrounding himself with every precaution to secure immunity for the crime. Such a one certainly is not the violent man whom passion blinds and who is instantaneously inflamed with anger. It is rather the degenerated man with whom predisposition has found the opportunity to reveal and to develop itself. It is necessary to add that Marin had a brother feeble in mind : an hereditary defect.

The true *bête humaine*, Jacques Lantier, possesses the anatomical characters of the born criminal ; "his thick black locks were curled, like his moustaches, so heavy and dark that they increased greatly the natural paleness of his complexion." Moreover, the inclination to crime in him was justified by inheritance. And this passion for murder which supplants the sensual passion is truly intoxicating. Where the author has gone astray is where he makes Jacques find pleasure for a considerable time with Séverine without any thought of murder ; while these unfortunates, at least all that I have studied, do not experience sexual pleasure except in murder. On the other hand, the vertigo of epileptic amnesia which Zola often causes Jacques to suffer, is based on fact and actually accords with the most recent observations :

"He had finally found himself on the brink of the Seine without being able to explain to himself how. That of which he retained a very clear impression, was of having thrown from the top of the bank the knife that his hand held clutched in his pocket. Then he knew no more, stupefied and absent of mind, out of which the other, and the knife too, had entirely vanished. . . . He was in his narrow chamber in the Rue Cardinet, fallen across his bed, fully dressed. Instinct had brought him back there, as a worn out dog crawls to his kennel. Besides he remembered neither having ascended the stairs, nor of having slept. He awoke from a heavy sleep, scared to re-enter abruptly into possession of himself, as after a profound fainting fit. Perhaps he had slept three hours, perhaps three days."

Never have I found a more perfect description of that which I have termed criminal, epileptoid vertigo. But here again is a mistake of fact arising from a velleity not content with knowledge. It is that the novelist several times explains these bloodthirsty sexual instincts by a peculiar kind of atavism : the tendency, namely, to avenge the evil that women had done to his race ; the spite accumulated from male to male since the first deceit in the depths of

caverns. This is an error of fact. Primitive women have never done wrong to men. More feeble than men, they have always been their victims. These bloodthirsty sexual instincts are explained by a quite different atavism, which goes back to inferior animals, to the conflict between the males for the conquest of the female, who remained for the strongest; and by the blows that were inflicted on the woman in order to reduce her to conjugal slavery, conflicts of which traces still remain in Roman history (the Rape of the Sabines), and in the nuptial rites of almost all European countries, and in those of New Zealand, where the husband knocks down his wife before carrying her off to the matrimonial bed.

Another technical defect is, that a man who has arrived at the degree of degeneracy that Jacques has, ought to have still other vices: as great violence of character, impulsiveness without cause, profound immorality; while, as a matter of fact, except in moments of sexual fury, he appears as a good and honorable man. However, even recognising the force of his bloody sexual monomania, I find that instinctive aversion, characteristic of the good man, to be proper which Jacques feels at the thought of killing some one who is not a young and beautiful woman; for instance, to killing his rival, notwithstanding the favorable circumstances and the suggestions of Séverine.

"To kill that man, my God! Had he the right to do it? When a fly troubled him he would crush it with a blow. One day when a cat had got between his legs, he had broken its back with a kick. But to kill this man, his fellow-creature! He must reason with himself, he must prove his right to murder; the right of the strong whom the weak are troublesome to. . . . But afterwards that appeared to him monstrous, impracticable, impossible. The civilised man revolted in him, the acquired force of education, the slow and indestructible concretion of inherited ideas. His cultivated brain, filled with scruples, repelled murder with horror, as soon as he began to reason about it. Yes, to kill in a case of necessity, in a transport of rage! But to kill voluntarily by design, and from interest, no never, never could he do it!"

All that is very true. Where the author has certainly copied after nature is in the personality of Séverine. She is not a true criminal; sensual, depraved though still young, experiencing love only in adultery. Though deceitful, she is nevertheless a good wife and a good housekeeper up to the day where chance had thrown her

into evil doing. She is united to her husband, and for that reason she becomes his accomplice in crime, without horror or dread; but afterwards, seized with love for Jacques, she experiences dislike for her husband and wishes to turn the lover into his murderer.

"The need increased in her of having Jacques for herself, all for herself, to live together, days and nights, without ever more parting. Her hatred of her husband grew greater, the mere presence of this man threw her into a morbid and intolerable condition of excitement. Tractable, and with all the amiability of a delicate woman, she became enraged at everything in which he was concerned; she flew into a passion at the least obstacle he put to her wishes. . . . The stupid tranquillity in which she saw him, the indifferent glance and manner with which he received her anger, his round back, his enlarged stomach, all that greasy dullness which has the appearance of happiness, made her exasperation complete. Oh! to go far away from him. . . . One day when he returned, pale and livid, to say that in passing before a locomotive he had felt the buffer graze his elbow, she thought to herself that if he were dead she would be free. . . . She would go with Jacques to America. . . . She who at other times so rarely went out now conceived a passion for going to see the steamships sail. She would go to the pier, and would lean on her elbow watching the smoke of the departing vessels. . . . [And at the decisive moment] she threw herself passionately on Jacques's neck. She fastened her burning lips to his. How she loved him and how she hated the other! Oh! if she had dared, twenty times already would she have done the deed . . . but she felt herself too gentle, it required the hand of a man. And this kiss which would never come to an end, was all that she could communicate to him of her courage, the full possession that she promised him, the communion of her body. When she finally withdrew her lips nothing more was left to her; she believed that she had passed completely into him."

And is this, then, the woman criminal, the criminaloid, as I have called her (Vol. II of my "*Uomo Delinquente*")? A criminal who, when she is not urged onward by opportunities, (and these opportunities always have love for their origin,) is not capable of any true crime, and who when she commits it always makes use of the arm of another; and this latter is always her lover, for she finds herself too feeble to accomplish it herself. Her anatomical characters, as well as her physiognomy, if not those of the born criminal, have at least some features which those of other females have not, and which unite her with the animal. "She had very black and very thick hair, which stood like a helmet on her forehead, a long face, a strong mouth, and large blue-green eyes."

M. Héricourt justly finds that many features of this woman are to be met with in Gabrielle Fenayron, the accomplice of her husband. Gabrielle Fenayron is about thirty years of age : she is a tall dark woman with a very pale complexion ; her hair is very black, the oval of her face elongated, and her eyes have a certain hardness that accentuate the projecting and unsightly cheek-bones. Gabrielle Fenayron, as we know, pretended to have been terrorised by the threats which her husband had uttered against her, and to have been infatuated, on the other hand, by the love that she felt for him ; she had thus submitted her will in order to repair her fault. In the appreciation of this system of defence, the bill of indictment stated that the energy and the coolness exhibited by this woman in the preparation of assassination, the facilities that she had during the course of the long premeditation which had preceded the murder to warn Aubert without danger to herself, induced the belief that she had in the commission of the crime yielded to a profound hatred against her old lover. But this interpretation appears to me, psychologically, to be a clumsy and a forced one. It is not necessary to have recourse to motives left mysterious in order to explain the absolutely strange conduct of some women.

Perhaps Zola would have completed his picture if he had known Gabrielle Gompard ; who allies and unites the passion of murder with prostitution when she attaches herself to a wicked man, but who grows animated for virtue and denounces herself an accomplice when she becomes the mistress of a virtuous man. These women change their personality in changing a lover, and then make a point of playing a rôle in the miserable world where their fickle passions destroy them.

Less happy, perhaps, has Zola been in the case of Flora, "fair, strong, with thick lips, and great greenish eyes, with low forehead set beneath heavy hair." According to the plot of the novel, she should be a criminal of passion. A good woman throughout her whole life, she commits a crime through jealousy. But the method of the crime (the derailment of a train with a view to striking her rival and her lover) is not that which is chosen by criminals of passion, who are unable to meditate long on their crimes, and

who kill in day-light without premeditation. It is true that it is natural to the mind of female criminals to deal indirect and very complicated blows, and without proportion to the end to be attained: but all this is only the effect of their weakness. In a virago as strong as Flora is depicted, (a bellicose maid with the strong and hard arms of a boy,) this reason fails to satisfy us; and when she meditates her crime she is urged much less by thoughts of revenge, than by a necessity to commit the wrong in order to become cured of her own; she is then a born criminal, an epileptic rather than a creature of passion; and in this sense the attribute that he gives to Flora of a monstrous muscular force, that is observed very frequently in born criminals, would be reasonable. Thus the girl who always wore masculine clothes had a remarkable muscular power. Her weapon was a hammer, and with it she struck down many men.

I knew at Turin a murderess, a courtesan, who when a model in Paris, killed for money and love an artist, whose portrait she carried tattooed on her arm. This unfortunate woman fought two or three times with the five wardens of her prison. When liberated she was the head of all the scoundrels of Turin, challenging them to contest. One day even I found her in a red shirt, with epaulettes on. "It is my ensign," said she to me, "I am the captain of the scoundrels of Turin." But all these women are very different from Flora. Of course, a single and only love is wanting in their case.

It will finally be said, that the propensity which casts the two criminaloid women into the arms of the born criminal, the *bête humaine*, is copied from nature. As a matter of fact, there does exist a true elective affinity which unites the two sexes of these unfortunates; a cause that gives rise to criminal families, which form the nucleus of gangs. Nevertheless, the demonstration of it in this instance is not evident, for in crowding a large number of criminals into so narrow a space, great liberty of choice is excluded.

II.

CRIMINAL ANTHROPOLOGY AND PSYCHIATRY.

Secretions.—Dr. Ottolenghi* has made in my laboratory a number of observations with 15 born criminals and 3 occasional criminals, for the purpose of ascertaining the proportional quantities of urea, chlorides, and phosphates eliminated under the same alimentary conditions. Here are the average results :

	GRAMMES.
Urea per 100 grammes of the weight of the body	<div> Born criminals..... 0'39 Occasional criminals.... 8'53 </div>
Phosphates.....do.....	<div> Born criminals..... 0'024 Occasional criminals.... 0'0195 </div>
Chlorides.....do.....	<div> Born criminals..... 0'28 Occasional criminals.... 0 29 </div>

There is therefore amongst the born criminals a diminution in the elimination of urea ; and an augmentation in that of phosphates, while the elimination of chlorides does not vary. He has obtained the same results in the case of psychical epilepsy ; while the occasional criminal offers no anomaly.

In connection with this it may be stated, that, on the other hand, Mr. Rivano† found amongst epileptics on the days of paroxysm a greater quantity of urea and less phosphates.

Power of Smell.—Dr. Ottolenghi has also studied the power of smell amongst criminals. He has contrived with this object in view an osmometer, containing 12 aqueous solutions of the essence of cloves varying from 1 part in 50,000 to 1 part in 100. He made his observations in several series, one each day only ; the conditions of ventilation being about the same, and the solutions being renewed for each observation, to avoid errors caused by evaporation. He looked first for the lowest degree at which olfactory perception began. In former experiments he proceeded differently. He disarranged the different bottles, and requested the subject to replace

* *Journal of the Medical Academy of Turin*, 1888. *Archiv. di Psichiatria, Scienze penali ed Antropologia Criminale*, Turin, 1888, x, Lombroso.

† *Archiv. di Freniatria*, Turin, 1889.

the same in the order of the intensity of their odor. He has divided the errors of disposition which resulted into serious and less serious errors, according as, in the order of the solutions, there occurred a distance of several or only one degree. He examined 80 criminals (50 men, 30 women) and 50 normal persons (30 men, mostly chosen amongst the prison warders, and 20 respectable women). Here are the results :

While amongst the normal males the average power of smell varied between the third and fourth degree of the osmometer, amongst the criminals it varied from the fifth to the sixth degree ; 44 individuals had no power of smell at all. While the honest men made an average of three errors in the disposition of the bottles, the criminals made five, of which three were so-called serious ones.

The normal women touched the fourth degree of the osmometer, the criminal women the sixth degree ; with two the power of smell was wanting entirely. While the normal women made an average of four faults in the disposition, the criminal women made five.

In eight cases of anosmia (loss of the sense of smell), presented in a certain set of criminals, two cases were due to nasal deformities ; the others were a kind of smell-blindness ; the subjects were susceptible to odoriferous excitations, but were unable to specify them and still less to classify them.

To verify what was really true in the assertion,* that criminal offenders against morality and customs have a highly developed power of smell, he examined this power in 30 ravishers and 40 prostitutes. In the former he found olfactory blindness in the ratio of 33 to 100 ; the remainder possessed an average power corresponding to the fifth degree of the osmometer. Arranging, then, the different solutions according to their intensity, he observed three so-called serious errors. In 19 per cent. of the girls submitted, he found olfactory blindness ; and for the others an average acuteness correspond-

* Krafft-Ebing, *Psychopatia sexualis*, 4th ed., Stuttgart, 1889.—*Archiv. di Psichiatria*, 1889.

ing to the fifth degree of the osmometer. Comparing these results with those obtained for the normal subjects and for regular criminals, the power of smell appears much less developed in the class just considered.

Taste.—Dr. Ottolenghi has also examined the sense of taste of 100 criminals (60 born criminals, 20 occasional criminals, and 20 criminal women). He compared them with 20 men taken from the lower classes, 20 professors and students, 20 respectable women, and 40 prostitutes. These series of experiments were made with 11 solutions of strychnine (graduated $\frac{1}{80000}$ to $\frac{1}{800000}$) and of saccharine (from $\frac{1}{100000}$ to $\frac{1}{10000}$), and 10 of chloride of sodium ($\frac{1}{800}$ to $\frac{3}{100}$). The criminals showed remarkable obtuseness. The lowest degree of acuteness was found in the proportion of 38 to 100 in born criminals, 30 to 100 in occasional criminals, 20 to 100 in criminal women; while we found it in 14 per cent. of the professors and the students, in 25 per cent. of the men from the lower classes, in 30 per cent. of the prostitutes, and finally in 10 per cent. of the respectable women.

Walk.—A study which I have made with *Perachia*,* shows us that, contrary to the case of normal men, the step of the left foot of criminals is generally longer than that of the right; besides they turn off from the line of the axis more to the right than to the left; their left foot, on being placed on the ground, forms with this line an angle of deviation more pronounced than the angle formed by their right foot; all these characteristics are very often found among epileptics.

Gestures.—It is an ancient habit among criminals to communicate their thoughts by gestures. Avé-Lallemant describes a set of gestures used among German thieves,—a real language executed solely with the fingers, like the language of the deaf. Vidocq says that pickpockets, when they are watching a victim, give each other the signal of Saint John, which consists in putting their hand to their cravat or even in taking off their hat. But Pitré especially has published the most important information on this point. In his "*Usi e Costumi della Sicilia*" (Usages and Customs of Sicily,)

* *Sur la Marche suivant la Méthode de Gilles de la Tourette.*

he describes 48 special kinds of gestures employed by delinquents. This phenomenon is explained by the exaggerated mobility with which born criminals are endowed, as is the case with children.

MORPHOLOGICAL ANOMALIES.

The Skeleton.—Mr. Tenchini, having made studies upon 63 skeletons of criminals, has found in the proportion of 6 out of 100 cases, the perforation of the olecranon (the bony prominence at the back of the elbow) which one observes in 36 out of 100 Europeans, and in 34 out of 100 Polynesians; he likewise observed additional ribs and vertebræ in 10 cases out of 100 of them, and also too few, in the same proportion; which reminds us of the great variability of these bones in the lower vertebrates. Lately he has even found in a criminal 4 sacral vertebræ too few, made up by 4 supplementary cervical vertebræ.

Madame Tarnorosky in her study of prostitutes, female thieves, and peasant women has demonstrated,* that the cranial capacity of prostitutes is inferior to that of female thieves and peasant women and particularly to that of women of good society; † *vice versa*, the zygomas (bones of the upper jaw) and the mandibles (lower jaw) were more developed among the prostitutes, who also exhibited a greater number of anomalies, in the proportion of 87 to 100, while the proportion of the female thieves showing anomalies was 79 to 100, and the proportion of peasant women was 12 to 100. The prostitutes had 33 in 100 of their parents addicted to drink, while the female thieves had 41 in 100 and the peasant women 16 in 100. Mr. De Albertis has found tattooing among 300 prostitutes of Genoa

* MEASUREMENTS.	50 PROSTI- TUTES.	100 PROSTI- TUTES.	100 FEMALE THIEVES.	50 PEASANT WOMEN. (NORTH.)	50 PEASANT WOMEN. (SOUTH.)	50 LADIES OF GOOD SOCIETY.
Anteropost. diam.....	17'7	17'8	17'9	18'3	18	18'3
Max. trans. diam.....	13'9	14'4	14'9	14'5	14'5	14'5
Max. circumference.....	52'9	53'3	53'5	52'7	53'6	58'8
Zygomatic dist.....	11'4	11'3	11'2	10'9	11'4	11'3
Mandib. biang. distance.....	10'1	10'18	9'1	9'1	9'9	9'8

† *Archiv. di Psichiatria*, Mierjeivki, 1887.—Ibid., 1888, p. 196.

in the enormous proportion of 70 in 100.* He has also found the tactile sensibility of the women very much diminished : 3·6 millimetres to the right and 4 millimetres to the left.

Among criminal women, Saloalto has made studies altogether new ; he has recognised among 130 female thieves the degenerative character, anomalies of the skull and of the physiognomy, in a less degree than among the men ; he has found brachycephaly in 7, oxycephaly in 29, platycephaly in 7, the retreating forehead in 7, strabismus in 11, protruding ears in 6 ; the sense of touch was normal in 2 out of 100, the reflexions of the tendons decreasing in 4 out of 100, exaggerated in 12 out of 100.

Marro and Marselli have explained by sexual selection this enormous difference, which one also finds among epileptics and particularly in insane people ; the men in fact do not choose ugly women with degenerative characters, while the women have no choice, and very often an ugly man, criminal, but vigorous, for this reason triumphs over all obstacles ; sometimes he is even preferred. (Flaubert, "Correspondance," 1889.) Let us add that the cares of maternity soften the character of women, and augment in them the sentiment of pity.

Dr. Ottolenghi † has studied in my laboratory the wrinkles of 200 criminals and 200 normal persons (workingmen and peasants), and he has found that they occur earlier and much more frequently among the criminals ; in fact, two to five times more so than among normal persons, with predominance of the zygomatic wrinkle (situated in the middle of each cheek), which wrinkle may well be called the wrinkle of vice, and is the characteristic wrinkle of criminals.

In criminal women (80) also, wrinkles have been found more frequent than in normal women, although here the difference is not so marked. One calls to mind at once the wrinkle of the sor-

* *Arch. di Psichiatria*, x, 1889.

† LOCATION.	UNDER 25 YEARS.		BETWEEN 25 AND 50 YEARS	
	NORMAL. p. 100.	CRIMINAL. p. 100.	NORMAL. p. 100.	CRIMINAL. p. 100.
Wrinkles of the forehead.....	7·1	34	62	86
Nasolabial wrinkles	22	69	62	78
Zygomatic wrinkles	0	16	18	33

cerers. It is enough to look at the bust of the celebrated Sicilian woman poisoner, preserved in the National Museum of Palermo, and whose face is one heap of wrinkles.

Dr. Ottolenghi, studying with me the frequency of canities (turning grey) and baldness in people, has demonstrated either absence or lateness of the same among criminals,* as also among epileptics and among cretins. Among the first, swindlers only tend to approach more the normal type.† On the other hand, among 280 criminal women canities was found more frequently, and baldness less frequently, than in the case of 200 honest workingmen.

We shall not terminate this part of our discussion without making mention of the beautiful discovery that we owe—it pleases us to state—to a lawyer, Mr. Anfosso. The tachyanthropometer which he has constructed is a real automatic measurer. (Archiv. di Psych., Art. IX. p. 173.) We might name it,—if the word did not possess a little too much local color,—an anthropometric guillotine; so quickly and with the precision of a machine, does it give the most important measurements of the body, which makes the practice of anthropometry very easy, even to people who are entire strangers to the science; and it facilitates, moreover, the examination of the description of individual criminals, the perfection of which will always remain one of the most glorious distinctions of M. Bertillon. And at the same time that this instrument renders services to the administration of justice, it permits on a grand scale observations which hitherto were only obtainable by the learned.

* *La Calvizie, la Canizie e le Rughe nei normali, nei criminali negli epilettici e nei cretini.* Archiv. di Psichiatria, 1889, x.

† CLASSES.	WITH CANITIES.	WITH BALDNESS.
	p. 100.	p. 100.
400 Normal people.....	62.5	19
80 Epileptics.....	31.5	12.7
40 Cretins.....	11.7	13.5
490 Criminals.....	25.9	48
Thieves.....	24.4	2.6
Swindlers.....	47	13.1
Maimers.....	23.7	5.3
80 Criminal women.....	45	9.7
200 Honest women.....	60	13

Experiments were made a short time ago by Mr. Rossi, who studied the result of these measurements in 100 criminals (nearly all thieves). He found the breadth of the span of the arms to be greater than the height of body in 88; and in 11 to be less. In 30 he found the right foot larger; in 58 he found the left foot larger; in 12 both feet equal. The right arms of 43 per cent. were longer than the left, and the left in 54 per cent. longer than the right. Which confirms to a marvellous degree the *gaucherie*, manciness, or structural misproportion, that had before been indicated by dynamometry and the study of the walk of criminals.*

The very frequent recurrence of anatomical misproportion and *gaucherie* could not be better confirmed; and there are in this atavistic symptoms, for Rollet has observed in 42 anthropoids the left humerus to be longer than the right, in the proportion of 60 to 100, while among men the proportion is only 7 out of 100. (*Revue Scientifique*, 1889.)

This anatomical misproportion I have very recently verified with Mr. Ottolenghi by measurements of the two hands, the middle fingers, and the feet, right and left, in 90 normal persons and in 100 born criminals.† (Archiv. di Psichiatria, X. 8.)

Tattooing—I was under the belief that in this respect nothing more was to be said after the beautiful studies of Messrs. Lacassagne and Marro, and after my own.‡

However, the researches made by Messrs. Severi, Lucchini, and Boselli on 4,000 new criminals have given results of a high importance and first of all a proportion eight fold greater than that of

* *Archiv. di Psichiatria*, 1889, Vol. x. p. 191.

† TYPES.	HAND LONGER.		MIDDLE FINGER.		FOOT.	
	RIGHT.	LEFT.	RIGHT.	LEFT.	RIGHT.	LEFT.
	PER CENTUM.		PER CENTUM.		PER CENTUM.	
Normal persons.....	14.4	11	16.6	15.5	38.5	15.6
Criminals.....	5	25	10	27	27	35
Swindlers.....	4.3	13	13	21.7	21.7	26
Ravishers.....	7	14.2	14.2	28.4	35.7	35.7
Maimers.....	15	25	5	25	20	55
Thieves.....	0	34.8	13	30.4	26	26.6
Pickpockets.....	0	35	5	30	35	25

‡ See *Nouvelle Revue*; also my *Uomo Delinquente*, 4th ed., 1889.

the alienists of the same district (Florence and Lucca). The prevalence of this practice is enormous ; it amounts to 40 in 100 among military criminals and to 33 in 100 among criminals under age ; the women give a proportion of only 1.6 in 100, but this would be increased to 2 in 100 if we included certain kinds of fly-tattooing (*tatouages mouches*) resembling beauty spots, which are found even in high life prostitution.

What chiefly astonishes us in these researches, next to the frequency of the phenomena, is the specific character of the tattooings : their obscenity, the vaunting of crime, and the strange contrast of evil passions and the highest sentiments.

M. C. . . ., aged 27 years, convicted at least fifty times for affrays, and the assaulting and wounding of men and horses, has the history of his crimes literally written on his skin ; and in this respect, let us note that the infamous De Rosny, who only lately committed suicide in Lyons, had her body covered with tattooings in the form of erotic figures ; one could read there the list of her lovers and the dates at which she left them.

F. L. . . ., a carrier, aged 26 years, several times convicted, bears on his breast a heart pierced by a poniard (the sign of vengeance), and on his right hand a female singer of a *café chantant*, of whom he was enamoured. By the side of these tattooings, and others which propriety forbids us to cite,* one sees with surprise the picture of a tomb with the epitaph : "To my beloved father." Strange contradictions of the human mind !

A certain B. . . ., a deserter, has on his chest a St. George and the cross of the Legion of Honor, and on the right arm a woman, very little dressed, who drinks with the inscription : "Let us wet the interior a little."

Q. A . . ., a laborer, convicted many times for theft, expelled from France and Switzerland, has on his chest two Swiss gendarmes with the words "Long live the Republic !" On his right arm he has a heart pierced through, and at the side the head of a fish—a mackerel, to signify that he will poniard a bully, his rival.

*See *Atlas de L'Homme Criminel*. 1888. Alcan.

We have seen on the left arm of another thief, a pot with a lemon tree, and the initials V. G. (*vengeance*) ; which in the strange language of the criminals means : treason, and, afterwards, revenge. He did not conceal from us the fact that his constant thought was to revenge himself on the woman who loved him and then abandoned him. His desire was to cut off her nose. His brother offered to perform the operation for him, but this he refused, reserving for himself the pleasure of executing his purpose when he should ultimately be liberated.

One sees, therefore, from these few examples, that there is among criminals a kind of hieroglyphical writing, but which is not regulated or fixed. The system is founded on daily happenings and slang, as would be the case among primitive mankind. Very often, in fact, a key signifies among thieves the silence of secrecy ; and a death's-head (the bare skull), revenge. Sometimes points are used instead of figures. In this way one criminal marked himself with 17 points, which means, to his mind, that he proposes to inflict injury on his enemy seventeen times, whenever he meets with him.

The criminal tattooers of Naples have the habit of making long inscriptions on their bodies ; but initials are used instead of words. Many Camorristes of Naples carry a tattooing which represents iron bars, behind which there is a prisoner and underneath the initials Q. F. Q. P. M., which means : "Quando finiranno queste pene ? Mai !" (When will these pains end ? Never !) Others bear the epigraph C. G. P. V., etc., which means : "Courage, galériens, pour voler et piler ; nous devons tout mettre à sang et à feu !" (Courage, convicts, to steal and to rob ; we must put all to the sword and fire !) We see here at once that certain forms of tattooing are employed by criminal federations, and serve as a sort of rallying-call. In Bavaria and in the South of Germany, the pickpockets, who are united together in real alliances, recognise each other by the epigraphic tattooing "T und L," which means *Thal und Land* (valley and country) ; words which they must exchange in a low voice when they meet each other, in order not to be denounced to the police. A thief R . . . , who has on his right arm a design representing two hands crossed, and the word *union* (unity) sur-

rounded by a garland of flowers, told us that this tattooing is extensively adopted by malefactors in the South of France (Draguignan). According to the revelations made to us by emerited Camorrist, a lizard or a serpent denotes the first grade of this dangerous association.

I pass over in silence, and for good reasons, the tattooings spread over all the remaining parts of the body.

In the *Revista de Antropologia Criminal*, a new publication which has just appeared in Madrid, Mr. Sallilas has published an excellent study relative to the tattooing of Spanish criminals. According to him, this is a frequent custom among murderers. The predominance of the religious character is there noticeable, but always with the seal of lewd obscenity, universally observed. I have lately had occasion to verify up to what point the impulsion which leads criminals to inflict on themselves this strange operation, is atavistic. One of the most incorrigible thieves I have met, who has six brothers tattooed like himself, begged of me, notwithstanding he was half covered with the most obscene tattooings, to find him a professional tattooer who should complete what might well be called the carpeting of his skin. "When the tattooing is very odd and grotesque, and spreads over the whole body," he said, "it is for us thieves what the black dress coat and the decorated vest is to society. The more we are tattooed the greater is our esteem for one another; the more an individual is tattooed, the more authority has he over his companions. On the other hand, he who is not much tattooed enjoys no influence whatsoever with us; is not considered a thorough scoundrel, and has not the estimation of his fellows." "Very often," another told me, "when we visited prostitutes, and they saw us covered all over with tattooings, they overwhelmed us with presents, and gave us money instead of demanding it." If all that is not atavism, atavism does not exist in science.

Of this characteristic, of course, as of all the other characteristics of criminals, one may say that it is to be met with among normal people. But the chief thing here is its proportion, its commonness, and the exaggerated extent to which it is practised. Among honest, respectable people its peculiar complexion, its local

and obscene coloring, and the useless, vain, and imprudent display of crime are wanting.

Again, it will probably be objected that this is not psychology, and that only through the latter science can we trace out the picture of the criminal. I could well answer here, that these tattooings are really psychological phenomena. And I may add that Mr. Ferri, in the introductory part of his work on Homicides, has given us in addition to a real statistical psychology, an analysis of all criminal propensities and of their extent before and after the crime.

Among born criminals, for example, 42 in 100 always deny the crime with which they are charged, while among occasional criminals, and in particular among maimers, only 21 in 100 deny all; of the first 1 in 100, and of the second 2 in 100 confess their crime with tears; etc.*

CESARE LOMBROSO.

[Prof. Lombroso has in preparation for this series of criminological studies, an essay on the physiognomy of the Anarchists.—ED.]

* *L'Omicidio*, Turin, 1890.

THE SQUARING OF THE CIRCLE.

AN HISTORICAL SKETCH OF THE PROBLEM FROM THE EARLIEST
TIMES TO THE PRESENT DAY.*

I.

FOR two and a half thousand years, both trained and untrained minds have striven in vain to solve the problem known as the squaring of the circle. Now that geometers have at last succeeded in giving a rigid demonstration of the im-
possibility of solving the problem with ruler and compasses, it seems fitting and opportune to cast a glance into the nature and history of this very ancient problem. And this will be found all the more justifiable in view of the fact that the squaring of the circle, at least in name, is very widely known outside of the narrow limits of professional mathematicians.

The Proceedings of the French Academy for the year 1775 contain at page 61 the resolution of the Academy not to examine from that time on, any so-called solutions of the quadrature of the circle that might be handed in. The Academy was driven to this determination by the overwhelming multitude of professed solutions of the famous problem, which were sent to it every month in the year,—solutions which of course were an invariable attestation of the ignorance and self-consciousness of their authors, but which suffered collectively from a very important error in mathematics: they were *wrong*. Since that time all professed solutions of the problem received by the Academy find a sure

Universal interest
in the problem.

The resolution of
the French Acad-
emy.

* From Holtzendorff and Virchow's *Sammlung gemeinverständlicher wissenschaftlicher Vorträge*, Heft 67. Hamburg: Verlagsanstalt, etc.

haven in the waste-basket, and remain unanswered for all time. The circle-squarer, however, sees in this high-handed manner of rejection only the envy of the great towards his grand intellectual discovery. He is determined to meet with recognition, and appeals therefore to the public. The newspapers must obtain for him the appreciation that scientific societies have denied. And every year the old mathematical sea-serpent more than once disports itself in the columns of our papers, that a Mr. N. N., of P. P., has at last solved the problem of the quadrature of the circle.

But what kind of people are these circle-squarers, when examined by the light? Almost always they will be found to be imperfectly educated persons, whose mathematical knowledge does not exceed that of a modern college freshman. It is seldom that they know accurately what the requirements of the problem are and what its nature; they never know the two and a half thousand years' history of the problem; and they have no idea whatever of the important investigations and results which have been made with reference to the problem by great and real mathematicians in every century down to our time.

Yet great as is the quantum of ignorance that circle-squarers intermix with their intellectual products, the lavish supply of conceit and self-consciousness with which they season their performances is still greater. I have not far to go to furnish a verification of this. A book printed in Hamburg in the year 1840 lies before me, in which the author thanks Almighty God at every second page that He has selected him and no one else to solve the 'problem phenomenal' of mathematics, "so long sought for, so fervently desired, and attempted by millions." After the modest author has proclaimed himself the unmasker of Archimedes's deceit, he says: "It thus has pleased our mother nature to withhold this mathematical jewel from the eye of human investigation, until she thought it fitting to reveal truth to simplicity."

This will suffice to show the great self-consciousness of the author. But it does not suffice to prove his ignorance. He has no conception of mathematical demonstration; he takes it for granted that things are so because they seem so to him. Errors of logic,

also, are abundantly found in his book. But apart from this general incorrectness let us see wherein the real gist of his fallacy consists. It requires considerable labor to find out what this is from the turgid language and bombastic style in which the author has buried his conclusions. But it is this. The author inscribes a square in a circle, circumscribes another about it, then points out that the inside square is made up of four congruent triangles, whereas the circumscribed square is made up of eight such triangles; from which fact, seeing that the circle is larger than the one square and smaller than the other, he draws the bold conclusion that the circle is equal in area to six such triangles. It is hardly conceivable that a rational being could infer that something which is greater than 4 and less than 8 must necessarily be 6. But with a man that attempts the squaring of the circle this kind of ratiocination is possible.

Similarly in the case of all other attempted solutions of the problem, either logical fallacies or violations of elementary arithmetical or geometrical truths may be pointed out. Only they are not always of such a trivial nature as in the book just mentioned.

Let us now inquire whence the inclination arises which leads people to take up the quadrature of the circle and to attempt to solve it.

Attention must first be called to the antiquity of the problem. A quadrature was attempted in Egypt 500 years before the exodus of the Israelites. Among the Greeks the problem never ceased to play a part that greatly influenced the progress of mathematics. And in the middle ages also the squaring of the circle sporadically appears as the philosopher's stone of mathematics. The problem has thus never ceased to be dealt with and considered. But it is not by the antiquity of the problem that circle-squarers are enticed, but by the allurements which everything exerts that is calculated to raise the individual out of the mass of ordinary humanity, and to bind about his temples the laurel crown of celebrity. It is ambition that spurred men on in ancient Greece and still spurs them on in modern times to crack this primeval mathematical nut. Whether they are competent thereto is a second

The allurements of the problem.

dary consideration. They look upon the squaring of the circle as the grand prize of a lottery that can just as well fall to their lot as to that of any other. They do not remember that—

“Toil before honor is placed by sagacious decrees of Immortals,”

and that it requires years of continued studies to gain possession of the mathematical weapons that are indispensably necessary to attack the problem, but which even in the hands of the most distinguished mathematical strategists have not sufficed to take the stronghold.

But how is it, we must further ask, that it happens to be the squaring of the circle and not some other unsolved mathematical problem upon which the efforts of people are bestowed who have no knowledge of mathematics yet busy themselves with mathematical questions? The question is answered by the fact that the squaring of the circle is about the only mathematical problem that is known to the unprofessional world,—at least by name. Even among the Greeks the problem was very widely known outside of mathematical circles. In the eyes of the Grecian layman, as at present among many of his modern brethren, occupation with this problem was regarded as the most important and essential business of mathematicians. In fact they had a special word to designate this species of activity; namely, *τετραγωνίζειν*, which means to busy one's self with the quadrature. In modern times, also, every educated person, though he be not a mathematician, knows the problem by name, and knows that it is insolvable, or at least, that despite the efforts of the most famous mathematicians it has not yet been solved. For this reason the phrase “to square the circle,” is now used in the sense of attempting the impossible.

But in addition to the antiquity of the problem, and the fact also that it is known to the lay world, we have yet a third factor to point out that induces people to take up with it. This is the report that has been spread abroad for a hundred years now, that the Academies, the Queen of England, or some other influential person, has offered a great prize to be given

About the only
problem known
to the lay world.

Belief that rewards
have been offered.

to the one that first solves the problem. As a matter of fact we find the hope of obtaining this large prize of money the principal incitement to action with many circle-squarers. And the author of the book above referred to begs his readers to lend him their assistance in obtaining the prizes offered.

Although the opinion is widely current in the unprofessional world, that professional mathematicians are still The problem among mathematicians. busied with the solution of the problem, this is by no means the case. On the contrary, for some two hundred years, the endeavors of many considerable mathematicians have been solely directed towards demonstrating with exactness that the problem is insolvable. It is, as a rule,—and naturally,—more difficult to prove that something is impossible than to prove that it is possible. And thus it has happened, that up to within a few years ago, despite the employment of the most varied and the most comprehensive methods of modern mathematics, no one succeeded in supplying the wished-for demonstration of the problem's impossibility. At last, Professor Lindemann, of Königsberg, in June, 1882, succeeded in furnishing a demonstration,—and the first demonstration,—that it is impossible by the exclusive employment of ruler and compasses to construct a square that is mathematically exactly equal in area to a given circle. The demonstration, naturally, was not effected with the help of the old elementary methods; for if it were, it would surely have been accomplished centuries ago; but methods were requisite that were first furnished by the theory of definite integrals and departments of higher algebra developed in the last decades; in other words it required the direct and indirect preparatory labor of many centuries to make finally possible a demonstration of the insolvability of this historic problem.

Of course, this demonstration will have no more effect than the resolution of the Paris Academy of 1775, in causing the fecund race of circle-squarers to vanish from the face of the earth. In the future as in the past, there will be people who know nothing, and will not want to know anything of this demonstration, and who believe that they cannot help but succeed in a matter in which others have failed, and that just they have been appointed by Providence to

solve the famous puzzle. But unfortunately the ineradicable passion of wanting to solve the quadrature of the circle has also its serious side. Circle-squarers are not always so self-contented as the author of the book we have mentioned. They often see or at least divine the insuperable difficulties that tower up before them, and the conflict between their aspirations and their performances, the consciousness that they want to solve the problem but are unable to solve it, darkens their soul and, lost to the world, they become interesting subjects for the science of psychiatry.

II.

If we have a circle before us, it is easy for us to determine the length of its radius or of its diameter, which must be double that of the radius; and the question next arises to find the number that represents how many times larger its circumference, that is the length of the circular line, is than its radius or its diameter. From the fact that all circles have the same shape it follows that this proportion will always be the same for both large and small circles. Now, since the time of Archimedes, all civilised nations that have cultivated mathematics, have called the number that denotes how many times larger than the diameter the circumference of a circle is, π ,—the Greek initial letter of the word periphery. To compute π , therefore, means to calculate how many times larger the circumference of a circle is than its diameter. This calculation is called "the numerical rectification of the circle."

Next to the calculation of the circumference, the calculation of the superficial contents of a circle by means of its radius or diameter is perhaps most important; that is, the computation of how much area that part of a plane which lies within a circle measures. This calculation is called the "numerical quadrature." It depends, however, upon the problem of numerical rectification; that is, upon the calculation of the magnitude of π . For it is demonstrated in elementary geometry, that the area of a circle is equal to the area of a triangle produced by drawing in the circle a radius, erecting at the extremity of the same a

tangent,—that is, in this case, a perpendicular,—cutting off upon the latter the length of the circumference, measuring from the extremity, and joining the point thus obtained with the centre of the circle. But it follows from this that the area of a circle is as many times larger than the square upon its radius as the number π amounts to.

The numerical rectification and numerical quadrature of the circle based upon the computation of the number π , Constructive rectification and quadrature. are to be clearly distinguished from problems that require a straight line equal in length to the circumference of a circle, or a square equal in area to a circle, to be *constructively* produced out of its radius or its diameter; problems which might properly be called “constructive rectification” or “constructive quadrature.” Approximately, of course, by employing an approximate value for π these problems are easily solvable. But to solve a problem of construction, in geometry, means to solve it with mathematical exactitude. If the value π were exactly equal to the ratio of two whole numbers to one another, the constructive rectification would present no difficulties. For example, suppose the circumference of a circle were exactly $3\frac{1}{4}$ times greater than its diameter; then the diameter could be divided into seven equal parts, which could be easily done by the principles of planimetry with ruler and compasses; then we would produce to the amount of such a part a straight line exactly three times larger than the diameter, and should thus obtain a straight line exactly equal to the circumference of the circle. But as a matter of fact, and as has actually been demonstrated, there do not exist two whole numbers, be they ever so great, that exactly represent by their proportion to one another the number π . Consequently, a rectification of the kind just described does not attain the object desired.

It might be asked here, whether from the demonstrated fact that the number π is not equal to the ratio of two whole numbers however great, it does not immediately follow that it is impossible to construct a straight line exactly equal in length to the circumference of a circle; thus demonstrating at once the impossibility of solving the problem. This question is to be answered in the nega-

tive. For there are in geometry many sets of two lines of which the one can be easily constructed from the other, notwithstanding the fact that no two whole numbers can be found to represent the ratio of the two lines. The side and the diagonal of a square, for instance, are so constituted. It is true the ratio of the latter two magnitudes is nearly that of 5 to 7. But this proportion is not exact, and there are in fact no two numbers that represent the ratio exactly. Nevertheless, either of these two lines can be easily constructed from the other by the sole employment of ruler and compasses. This might be the case, too, with the rectification of the circle; and consequently from the impossibility of representing π by the ratio between two whole numbers the impossibility of the problem of rectification is not inferable.

The quadrature of the circle stands and falls with the problem of rectification. This is based upon the truth above mentioned, that a circle is equal in area to a right-angled triangle, in which one side is equal to the radius of the circle and the other to the circumference. Supposing, accordingly, that the circumference of the circle were rectified, then we could construct this triangle. But every triangle, as is taught in the elements of planimetry, can, with the help of ruler and compasses be converted into a square exactly equal to it in area. So that, therefore, supposing the rectification of the circumference of a circle were successfully performed, a square could be constructed that would be exactly equal in area to the circle.

The dependence upon one another of the three problems of the computation of the number π , of the quadrature of the circle, and its rectification, thus obliges us, in dealing with the history of the quadrature, to regard investigations with respect to the value of π and attempts to rectify the circle as of equal importance, and to consider them accordingly.

We have used repeatedly in the course of this discussion the expression "to construct with ruler and compasses."

It will be necessary to explain what is meant by the specification of these two instruments. When such a number of conditions is annexed to a requirement in geometry to construct a

Conditions of the
geometrical solu-
tion.

certain figure that the construction only of *one* figure or a limited number of figures is possible in accordance with the conditions given; such a complete requirement is called a problem of construction, or briefly a problem. When a problem of this kind is presented for solution it is necessary to reduce it to simpler problems, already recognised as solvable; and since these latter depend in their turn upon other, still simpler problems, we are finally brought back to certain fundamental problems upon which the rest are based but which are not themselves reducible to problems less simple. These fundamental problems are, so to speak, the undermost stones of the edifice of geometrical construction. The question next arises as to what problems may be properly regarded as fundamental; and it has been found, that the solution of a great part of the problems that arise in elementary planimetry rests upon the solution of only five original problems. They are:

1. The construction of a straight line which shall pass through two given points.
2. The construction of a circle the centre of which is a given point and the radius of which has a given length.
3. The determination of the point that lies coincidently on two given straight lines extended as far as is necessary,—in case such a point (point of intersection) exists.
4. The determination of the two points that lie coincidently on a given straight line and a given circle,—in case such common points (points of intersection) exist.
5. The determination of the two points that lie coincidently on two given circles,—in case such common points (points of intersection) exist.

For the solution of the three last of these five problems the eye alone is needed, while for the solution of the two first problems, besides pencil, ink, chalk, and the like, additional special instruments are required: for the solution of the first problem a ruler is most generally used, and for the solution of the second a pair of compasses. But it must be remembered that it is no concern of geometry what mechanical instruments are employed in the solution of the five problems mentioned. Geometry simply limits itself to

the presupposition that these problems are solvable, and regards a complicated problem as solved if, upon a specification of the constructions of which the solution consists, no other requirements are demanded than the five above mentioned. Since, accordingly, geometry does not itself furnish the solution of these five problems, but rather exacts them, they are termed *postulates*.* All problems of planimetry are not reducible to these five problems alone. There are problems that can be solved only by assuming other problems as solvable which are not included in the five given; for example, the construction of an ellipse, having given its centre and its major and minor axes. Many problems, however, possess the property of being solvable with the assistance solely of the five postulates above formulated, and where this is the case they are said to be "constructible with ruler and compasses," or "elementarily" constructible.

After these general remarks upon the solvability of problems of geometrical construction, which an understanding of the history of the squaring of the circle makes indispensably necessary, the significance of the question whether the quadrature of the circle is or is not solvable, that is elementarily solvable, will become intelligible. But the conception just discussed of elementary solvability only gradually took clear form, and we therefore find among the Greeks as well as among the Arabs, endeavors, successful in some respects, that aimed at solving the quadrature of the circle with other expedients than the five postulates. We have also to take these endeavors into consideration, and especially so as they, no less than the unsuccessful efforts at elementary solution, have upon the whole advanced the science of geometry, and contributed much to the clarification of geometrical ideas.

* Usually geometers mention only two postulates (Nos. 1 and 2). But since to geometry proper it is indifferent whether only the eye, or additional special mechanical instruments are necessary, the author has regarded it more correct in point of method to assume five postulates.

III.

In the oldest mathematical work that we possess we find a rule that tells us how to make a square which is equal in area to a given circle. This celebrated book, the The Egyptian quadrature. Papyrus Rhind of the British Museum, translated and explained by Eisenlohr (Leipsic, 1887), was written, as it is stated in the work, in the thirty-third year of the reign of King Ra-a-us, by a scribe of that monarch, named Ahmes. The composition of the work falls accordingly into the period of the two Hiksos dynasties, that is, in the period between 2000 and 1700 B.C. But there is another important circumstance attached to this. Ahmes mentions in his introduction that he composed his work after the model of old treatises, written in the time of King Raenmat; whence it appears that the originals of the mathematical expositions of Ahmes, are half a thousand years older yet than the Papyrus Rhind.

The rule given in this papyrus for obtaining a square equal to a circle, specifies that the diameter of the circle shall be shortened one ninth of its length and upon the shortened line thus obtained a square erected. Of course, the area of a square of this construction is only approximately equal to the area of the circle. An idea may be obtained of the degree of exactness of this original, primitive quadrature by our remarking, that if the diameter of the circle in question is one metre in length, the square that is supposed to be equal to the circle is a little less than half a square decimetre larger; an approximation not so accurate as that computed by Archimedes, yet much more correct than many a one later employed. It is not known how Ahmes or his predecessors arrived at this approximate quadrature; but it is certain that it was handed down in Egypt from century to century, and in late Egyptian times it repeatedly appears.

Besides among the Egyptians, we also find in pre-Grecian antiquity an attempt at circle-computation among the The Biblical and Babylonian quadratures. Babylonians. This is not a quadrature; but aims at the rectification of the circumference. The Babylonian mathematicians had discovered, that if the radius of a circle be successively

inscribed as chord within its circumference, after the sixth inscription we arrive at the point of departure, and they concluded from this that the circumference of a circle must be a little larger than a line which is six times as long as the radius, that is three times as long as the diameter. A trace of this Babylonian method of computation may even be found in the bible; for in 1 Kings vii. 23, and 2 Chron. iv. 2, the great laver is described, which under the name of the "molten sea" constituted an ornament of the temple of Solomon; and it is said of this vessel that it measured ten cubits from brim to brim, and thirty cubits round about. The number 3 as the ratio between the circumference and the diameter is still more plainly given in the Talmud, where we read that "that which measures three lengths in circumference is one length across."

With regard to the earlier Greek mathematicians,—as Thales and Pythagoras,—we know that they acquired the foundations of their mathematical knowledge in Egypt. But nothing has been handed down to us which shows that they knew of the old Egyptian quadrature, or that they dealt with the problem at all. But tradition says, that, subsequently, the teacher of Euripides and Pericles, the great philosopher and mathematician Anaxagoras, whom Plato so highly praised, "drew the quadrature of the circle" in prison, in the year 434. This is the account of Plutarch in the seventeenth chapter of his work "De Exilio." The method is not told us in which Anaxagoras had supposedly solved the problem, and it is not said whether knowingly or unknowingly he accomplished an approximate solution after the manner of Ahmes. But at any rate, to Anaxagoras belongs the merit of having called attention to a problem that bore great fruit, in having incited Grecian scholars to busy themselves with geometry, and thus more and more to advance that science.

Again, it is reported that the mathematician Hippias of Elis invented a curved line that could be made to serve a double purpose: first, to trisect an angle, and second, to square the circle. This curved line is the τετραγωνίζουσα

so often mentioned by the later Greek mathematicians, and by the Romans called "quadratrix." Regarding the nature of this curve we have exact knowledge from Pappus. But it will be sufficient, here, to state that the quadratrix is not a circle nor a portion of a circle, so that its construction is not possible by means of the postulates enumerated in the preceding section. And therefore the solution of the quadrature of the circle founded on the construction of the quadratrix is not an elementary solution in the sense discussed in the last section. We can, it is true, conceive a mechanism that will draw this curve as well as compasses draw a circle; and with the assistance of a mechanism of this description the squaring of the circle is solvable with exactitude. But if it be allowed to employ in a solution an apparatus especially adapted thereto, every problem may be said to be solvable. Strictly taken, the invention of the curve of Hippias substitutes for one insuperable difficulty another equally insuperable. Some time afterwards, about the year 350, the mathematician Dinostratus showed that the quadratrix could also be used to solve the problem of rectification, and from that time on this problem plays almost the same rôle in Grecian mathematics as the related problem of quadrature.

As these problems gradually became known to the non-mathematicians of Greece, attempts at solution at once sprang up that are worthy of a place by the side of ^{The Sophists' solution.} the solutions of modern amateur circle-squarers. The Sophists, especially, believed themselves competent by seductive dialectic to take a stronghold that had defied the intellectual onslaughts of the greatest mathematicians. With verbal nicety, amounting to puerility, it was said that the squaring of the circle depended upon the finding of a number which represented in itself both a square and a circle; a square by being a square number, a circle in that it ended with the same number as the root number from which, by multiplication with itself, it was produced. The number 36, accordingly, was, as they thought, the one that embodied the solution of the famous problem.

Contrasted with this twisting of words the speculations of Bryson and Antiphon, both contemporaries of Socrates, though inexact,

appear in high degree intelligent. Antiphon divided the circle into four equal arcs, and by joining the points of division obtained a square; he then divided each arc again into two equal parts and thus obtained an inscribed octagon; thence he constructed an inscribed dodecagon, and perceived that the figure so inscribed more and more approached the shape of a circle. In this way, he said, one should proceed, until there was inscribed in the circle a polygon whose sides by reason of their smallness should coincide with the circle. Now this polygon could, by methods already taught by the Pythagoreans, be converted into a square of equal area; and upon the basis of this fact Antiphon regarded the squaring of the circle as solved.

Nothing can be said against this method except that, however far the bisection of the arcs is carried, the result must still remain an approximate one.

The attempt of Bryson of Heraclea was better still; for this scholar did not rest content with finding a square that was very little smaller than the circle, but obtained by means of circumscribed polygons another square that was very little larger than the circle. Only Bryson committed the error of believing that the area of the circle was the arithmetical mean between an inscribed and a circumscribed polygon of an equal number of sides. Notwithstanding this error, however, to Bryson belongs the merit, first, of having introduced into mathematics by his emphasis of the necessity of a square which was too large and one which was too small, the conception of maximum and minimum "limits" in approximations; and secondly, by his comparison with a circle of the inscribed and circumscribed regular polygons, the merit of having indicated to Archimedes the way by which an approximate value for π was to be reached.

Not long after Antiphon and Bryson, Hippocrates of Chios treated the problem, which had now become more and more famous, from a new point of view. Hippocrates was not satisfied with approximate equalities, and searched for curvilinearly bounded plane figures which should be mathematically equal to a rectilinearly bounded figure, and therefore

could be converted by ruler and compasses into a square equal in area. First, Hippocrates found that the crescent-shaped plane figure produced by drawing two perpendicular radii in a circle and describing upon the line joining their extremities a semicircle, is exactly equal in area to the triangle that is formed by this line of junction and the two radii; and upon the basis of this fact the endeavors of the untiring scholar were directed towards converting a circle into a crescent. Naturally he was unable to attain this object, but by his efforts to this end he discovered many a new geometrical truth; among others the generalised form of the theorem mentioned, which bears to the present day the name of "Lunulae Hippocratis," the lunes of Hippocrates. Thus it appears, in the case of Hippocrates, in the plainest light, how the very insolvable problems of science are qualified to advance science; in that they incite investigators to devote themselves with persistence to its study and thus to fathom its depths.

Following Hippocrates in the historical line of the great Grecian geometers comes the systematist Euclid, Euclid's avoidance of the problem. whose rigid formulation of geometrical principles has remained the standard presentation down to the present century. The Elements of Euclid, however, contain nothing relating to the quadrature of the circle or to circle-computation. Comparisons of surfaces which relate to the circle are indeed found in the book, but nowhere a computation of the circumference of a circle or of the area of a circle. This palpable gap in Euclid's system was filled by Archimedes, the greatest mathematician of antiquity.

Archimedes was born in Syracuse in the year 287 B. C., and devoted his life, there spent, to the mathematical and Archimedes's calculations. the physical sciences, which he enriched with invaluable contributions. He lived in Syracuse till the taking of the town by Marcellus, in the year 212 B. C., when he fell by the hand of a Roman soldier whom he had forbidden to destroy the figures he had drawn in the sand. To the greatest performances of Archimedes the successful computation of the number π unquestionably belongs. Like Bryson he started with regular inscribed and circumscribed polygons. He showed how it was possible, beginning with

the perimeter of an inscribed hexagon, which is equal to six radii, to obtain by way of calculation the perimeter of a regular dodecagon, and then the perimeter of a figure having double the number of sides of the preceding one. Treating, then, the circumscribed polygons in a similar manner, and proceeding with both series of polygons up to a regular 96-sided polygon, he perceived on the one hand that the ratio of the perimeter of the inscribed 96-sided polygon to the diameter was greater than $6336 : 2017\frac{1}{4}$, and on the other hand, that the corresponding ratio with respect to the circumscribed 96-sided polygon was smaller than $14688 : 4673\frac{1}{2}$. He inferred from this, that the number π , the ratio of the circumference to the diameter, was greater than the fraction $\frac{6336}{2017\frac{1}{4}}$ and smaller than $\frac{14688}{4673\frac{1}{2}}$. Reducing the two limits thus found for the value of π , Archimedes then showed that the first fraction was greater than $3\frac{1}{7}$, and that the second fraction was smaller than $3\frac{1}{7}$, whence it followed with certainty that the value sought for π lay between $3\frac{1}{7}$ and $3\frac{1}{7}$. The larger of these two approximate values is the only one usually learned and employed. That which fills us most with astonishment in the Archimedean computation of π , is, first, the great acumen and accuracy displayed in all the details of the computation, and then the unwearied perseverance that he must have exercised in calculating the limits of π without the advantages of the Arabian system of numerals and of the decimal notation. For it must be considered that at many stages of the computation what we call the extraction of roots was necessary, and that Archimedes could only by extremely tedious calculations obtain ratios that expressed approximately the roots of given numbers and fractions.

With regard to the mathematicians of Greece that follow Archimedes, all refer to and employ the approximate value of $3\frac{1}{7}$ for π , without however, contributing anything essentially new or additional to the problems of quadrature and of cyclometry. Thus Heron of Alexandria, the father of surveying, who flourished about the year 100 B. C., employs for purposes of practical measurement sometimes the value $3\frac{1}{7}$ for π and sometimes even the rougher approximation $\pi = 3$. The astronomer

The later mathematicians of Greece.

Ptolemy, who lived in Alexandria about the year 150 A. D., and who was famous as being the author of the planetary system universally recognised as correct down to the time of Copernicus, was the only one who furnished a more exact value; this he designated, in the sexagesimal system of fractional notation which he employed, by 3, 8, 30,—that is 3 and $\frac{8}{60}$ and $\frac{30}{3600}$, or as we now say 3 degrees, 8 minutes (*partes minutae primae*), and 30 seconds (*partes minutae secundae*). As a matter of fact, the expression $3 + \frac{8}{60} + \frac{30}{3600} = 3.1\frac{17}{20}$ ✓ represents the number π more exactly than $3\frac{1}{4}$; but on the other hand, is, by reason of the magnitude of the numbers 17 and 120 as compared with the numbers 1 and 7, more cumbersome.

IV.

In the mathematical sciences, more than in any other, the Romans stood upon the shoulders of the Greeks. In- Among the Romans deed, with respect to cyclometry, they not only did not add anything to the Grecian discoveries, but often evinced even that they either did not know of the beautiful result obtained by Archimedes, or at least did not know how to appreciate it. For instance, Vitruvius, who lived during the time of Augustus, computed that a wheel 4 feet in diameter must measure $12\frac{1}{2}$ feet in circumference; in other words, he made π equal to $3\frac{1}{4}$. And, similarly, a treatise on surveying, preserved to us in the Gudian manuscript of the library at Wolfenbüttel, contains the following instructions to square the circle: Divide the circumference of a circle into four parts and make one part the side of a square; this square will be equal in area to the circle. Aside from the fact that the rectification of the arc of a circle is requisite to the construction of a square of this kind, the Roman quadrature, viewed as a calculation, is more inexact even than any other computation; for its result is that $\pi = 4$. ✓

The mathematical performances of the Hindus were not only greater than those of the Romans, but in certain Among the Hindus. directions even surpassed those of the Greeks. In the most ancient source for the mathematics of India that we know of, the *Culvasûtras*, which date back to a little before our chronological era, we do not find, it is true, the squaring of the

circle treated of, but the opposite problem is dealt with, which might fittingly be termed the circling of the square. The half of the side of a given square is prolonged one third of the excess in length of half the diagonal over half the side, and the line thus obtained is taken as the radius of the circle equal in area to the square. The simplest way to obtain an idea of the exactness of this construction is to compute how great π would have to be if the construction were exactly correct. We find out in this way that the value of π upon which the Indian circling of the square is based, is about from five to six hundredths smaller than the true value, whereas the approximate π of Archimedes, $3\frac{1}{2}$, is only from one to two thousandths too large, and the old Egyptian value exceeds the true value by from one to two hundredths. Cyclometry very probably made great advances among the Hindus in the first four or five centuries of our era; for Aryabhata, who lived about the year 500 after Christ, states, that the ratio of the circumference to the diameter is 62832 : 20000, an approximation that in exactness surpasses even that of Ptolemy. The Hindu result gives 3.1416 for π , while π really lies between 3.141592 and 3.141593. How the Hindus obtained this excellent approximate value is told by Ganeça, the commentator of Bhâskara, an author of the twelfth century. Ganeça says that the method of Archimedes was carried still farther by the Hindu mathematicians; that by continually doubling the number of sides they proceeded from the hexagon to a polygon of 384 sides, and that by the comparison of the circumferences of the inscribed and circumscribed 384-sided polygons they found that π was equal to 3927 : 1250. It will be seen that the value given by Bhâskara is identical with the value of Aryabhata. It is further worthy of remark that the earlier of these two Hindu mathematicians does not mention either the value $3\frac{1}{2}$ of Archimedes or the value $3\frac{1}{170}$ of Ptolemy, but that the later knows of both values and especially recommends that of Archimedes as the most useful one for practical application. Strange to say, the good approximate value of Aryabhata does not occur in Bramagupta, the great Hindu mathematician who flourished in the beginning of the seventh century; but we find the curious information in this author that the area of a circle is exactly equal to the

square root of 10 when the radius is unity. The value of π as derivable from this formula,—a value from two to three hundredths too large,—has unquestionably arisen upon Hindu soil. For it occurs in no Grecian mathematician; and Arabian authors, who were in a better position than we to know Greek and Hindu mathematical literature, declare that the approximation which makes π equal to the square root of 10, is of Hindu origin. It is possible that the Hindu people, who were addicted more than any other to numeral mysticism, sought to find in this approximation some connection with the fact that man has ten fingers; and ten accordingly is the basis of their numeral system.

Reviewing the achievements of the Hindus generally with respect to the problem of the quadrature, we are brought to recognise that this people, whose talents lay more in the line of arithmetical computation than in the perception of spatial relations, accomplished as good as nothing on the pure geometrical side of the problem, but that the merit belongs to them of having carried the Archimedean method of computing π several stages farther, and of having obtained in this way a much more exact value for it—a circumstance that is explainable when we consider that the Hindus are the inventors of our present system of numeral notation, possessing which they easily outdid Archimedes, who employed the awkward Greek system.

With regard to the Chinese, this people operated in ancient times with the Babylonian value for π , or 3; but ^{among the Chinese} possessed knowledge of the approximate value of Archimedes at least since the end of the sixth century. Besides this, there appears in a number of Chinese mathematical treatises an approximate value peculiarly their own, in which $\pi = 3\frac{7}{10}$; a value, however, which notwithstanding it is written in larger figures, is no better than that of Archimedes. Attempts at the *constructive* quadrature of the circle are not found among the Chinese.

Greater were the merits of the Arabians in the advancement and development of mathematics; and especially in ^{Among the Arabs.} virtue of the fact that they preserved from oblivion both Greek and Hindu mathematics, and handed them down to the

Christian countries of the West. The Arabians expressly distinguished between the Archimedean approximate value and the two Hindu values the square root of 10 and the ratio 62832 : 20000. This distinction occurs also in Muhammed Ibn Musa Alchwarizmi, the same scholar who in the beginning of the ninth century brought the principles of our present system of numerical notation from India and introduced the same into the Mohammedan world. The Arabians, however, did not study the numerical quadrature of the circle only, but also the constructive; as, for instance, Ibn Alhaitam, who lived in Egypt about the year 1000 and whose treatise upon the squaring of the circle is preserved in a Vatican codex, which has unfortunately not yet been edited.

Christian civilisation, to which we are now about to pass, produced up to the second half of the fifteenth century extremely insignificant results in mathematics. Even with regard to our present problem we have but a single important work to mention; the work, namely, of Frankos Von Lüttich, upon the squaring of the circle, published in six books, but only preserved in fragments. The author, who lived in the first half of the eleventh century, was probably a pupil of Pope Sylvester II, himself a not inconsiderable mathematician for his time, and who also wrote the most celebrated book on geometry of the period.

Greater interest came to be bestowed upon mathematics in general, but especially on the problem of the quadrature of the circle, in the second half of the fifteenth century, when the sciences again began to revive. This interest was especially aroused by Cardinal Nicolaus De Cusa, a man highly esteemed on account of his astronomical and calendrical studies. He claimed to have discovered the quadrature of the circle by the employment solely of compasses and ruler, and thus attracted the attention of scholars to the now historic problem. People believed the famous Cardinal, and marvelled at his wisdom, until Regiomontanus, in letters which he wrote in 1464 and 1465 and which were published in 1533, rigidly demonstrated that the Cardinal's quadrature was incorrect. The construction of Cusa was as follows. The radius of a circle is prolonged a distance equal to the

side of the inscribed square; the line thus obtained is taken as the diameter of a second circle and in the latter an equilateral triangle is described; then the perimeter of the latter is equal to the circumference of the original circle. If this construction, which its inventor regarded as exact, be considered as a construction of approximation, it will be found to be more inexact even than the construction resulting from the value $\pi = 3\frac{1}{2}$. For by Cusa's method π would be from five to six thousandths smaller than it really is.

In the beginning of the sixteenth century a certain Bovillius appears, who announced anew the construction of Bovillius and Orontius Finaeus. Cusa; meeting however with no notice. But about the middle of the sixteenth century a book was published which the scholars of the time at first received with interest. It bore the proud title "*De Rebus Mathematicis Hactenus Desideratis.*" Its author, Orontius Finaeus, represented that he had overcome all the difficulties that had ever stood in the way of geometrical investigators; and incidentally he also communicated to the world the "true quadrature" of the circle. His fame was short-lived. For soon afterwards, in a book entitled "*De Erratis Orontii,*" the Portuguese Petrus Nonius demonstrated that Orontius's quadrature, like most of his other professed discoveries, was incorrect.

In the period following this the number of circle-squarers so increased that we shall have to limit ourselves to Simon Van Eyck. those whom mathematicians recognise. And particularly is Simon Van Eyck to be mentioned, who towards the close of the sixteenth century published a quadrature which was so approximate that the value of π derived from it was more exact than that of Archimedes; and to disprove it the mathematician Peter Metius was obliged to seek a still more accurate value than $3\frac{1}{2}$. The erroneous quadrature of Van Eyck was thus the occasion of Metius's discovery that the ratio 355:113, or $3\frac{1}{113}$, varied from the true value of π by less than one one-millionth, eclipsing accordingly all values hitherto obtained. Moreover, it is demonstrable by the theory of continued fractions, that, admitting figures to four places only, no two numbers more exactly represent the value of π than 355 and 113.

In the same way the quadrature of the great philologist Joseph Scaliger led to refutations. Like most circle-squarers who believe in their discovery, Scaliger also was little versed in the elements of geometry. He solved, however,—at least in his own opinion he did,—the famous problem; and published in 1592 a book upon it, which bore the pretentious title “Nova Cyclometria” and in which the name of Archimedes was derided. The worthlessness of his supposed discovery was demonstrated to him by the greatest mathematicians of his time; namely, Vieta, Adrianus Romanus, and Clavius.

Of the erring circle-squarers that flourished before the middle of the seventeenth century three others deserve particular mention—Longomontanus of Copenhagen, who rendered such great services to astronomy, the Neapolitan John Porta, and Gregory of St. Vincent. Longomontanus made $\pi = 3\frac{14188}{100000}$, and was so convinced of the correctness of his result that he thanked God fervently, in the preface to his work “Inventio Quadraturæ Circuli,” that He had granted him in his high old age the strength to conquer the celebrated difficulty. John Porta followed the initiative of Hippocrates, and believed he had solved the problem by the comparison of lunes. Gregory of St. Vincent published a quadrature, the error of which was very hard to detect but was finally discovered by Descartes.

Of the famous mathematicians who dealt with our problem in the period between the close of the fifteenth century and the time of Newton, we first meet with Peter Metius, before mentioned, who succeeded in finding in the fraction $355:113$ the best approximate value for π involving only small numbers. The problem received a different advancement at the hands of the famous mathematician Vieta. Vieta was the first to whom the idea occurred of representing π with mathematical exactness by an infinite series of continuable operations. By comparison of inscribed and circumscribed polygons, Vieta found that we approach nearer and nearer to π if we allow the operations of the extraction of the square root of $\frac{1}{2}$, and of addition and of multiplication to succeed each other in a certain manner, and that π must come out exactly,

if this series of operations could be indefinitely continued. Vieta thus found that to a diameter of 10000 million units a circumference belongs of 31415 million and from 926535 to 926536 units of the same length.

But Vieta was outdone by the Netherlander Adrianus Romanus, who added five additional decimal places to the ten Adrianus Romanus, Ludolf Van Ceulen. of Vieta. To accomplish this he computed with unspeakable labor the circumference of a regular circumscribed polygon of 1073741824 sides. This number is the thirtieth power of 2. Yet great as the labor of Adrianus Romanus was, that of Ludolf Van Ceulen was still greater; for the latter calculator succeeded in carrying the Archimedean process of approximation for the value of π to 35 decimal places, that is, the deviation from the true value was smaller than one one-thousand quintillionth, a degree of exactness that we can hardly have any conception of. Ludolf published the figures of the tremendous computation that led to this result. His calculation was carefully examined by the mathematician Griemberger and declared to be correct. Ludolf was justly proud of his work, and following the example of Archimedes, requested in his will that the result of his most important mathematical performance, the computation of π to 35 decimal places, be engraved upon his tombstone; a request which is said to have been carried out. In honor of Ludolf, π is called to-day in Germany the Ludolfian number. ✓

Although through the labor of Ludolf a degree of exactness for cyclometrical operations was now obtained that was more than sufficient for any practical purpose that The new method of Snell. Huygens's verification of it. could ever arise, neither the problem of constructive rectification nor that of constructive quadrature was thereby in any respect theoretically advanced. The investigations conducted by the famous mathematicians and physicists Huygens and Snell about the middle of the seventeenth century, were more important from a mathematical point of view than the work of Ludolf. In his book "Cyclometricus" Snell took the position that the method of comparison of polygons, which originated with Archimedes and was employed by Ludolf, need by no means be the best method of at-

taining the end sought; and he succeeded by the employment of propositions which state that certain arcs of a circle are greater or smaller than certain straight lines connected with the circle, in obtaining methods that make it possible to reach results like the Ludolfian with much less labor of calculation. The beautiful theorems of Snell were proved a second time, and better proved, by the celebrated Dutch promoter of the science of optics, Huygens (*Opera Varia*, p. 365 et seq.; "*Theoremata De Circuli et Hyperbolae Quadratura*," 1651), as well as perfected in many ways. Snell and Huygens were fully aware that they had advanced only the problem of numerical quadrature, and not that of the constructive quadrature. This, in Huygens's case, plainly appeared from the vehement dispute he conducted with the English mathematician James Gregory. This controversy has some significance for the history of our problem, from the fact that Gregory made the first attempt to prove that the squaring of the circle with ruler and compasses must be impossible. The result of the controversy, to which we owe many valuable treatises, was, that Huygens finally demonstrated in an incontrovertible manner the incorrectness of Gregory's proof of impossibility, adding that he also was of opinion that the solution of the problem with ruler and compasses was impossible, but nevertheless was not himself able to demonstrate this fact. And Newton, later, expressed himself to a similar effect. As a matter of fact it took till the most recent period, that is over 200 years, until higher mathematics was far enough advanced to furnish a rigid demonstration of impossibility.

The controversy between Huygens and Gregory.

V.

Before we proceed to consider the promotive influence which the invention of the differential and the integral calculus had upon our problem, we shall enumerate a few at least of that never-ending line of mistaken quadrators who delighted the world by the fruits of their ingenuity from the time of Newton to the present period; and out of a pious and sincere consideration for the contemporary world, we shall entirely omit in this to speak of the circle-squarers of our own time.

First to be mentioned is the celebrated English philosopher Hobbes. In his book "*De Problematis Physicis*," Hobbes's quadrature. in which he chiefly proposes to explain the phenomena of gravity and of ocean tides, he also takes up the quadrature of the circle and gives a very trivial construction that in his opinion definitively solved the problem, making $\pi = 3\frac{1}{4}$. In view of Hobbes's importance as a philosopher, two mathematicians, Huygens and Wallis, thought it proper to refute Hobbes at length. But Hobbes defended his position in a special treatise, in which to sustain at least the appearance of being right, he disputed the fundamental principles of geometry and the theorem of Pythagoras; so that mathematicians could pass on from him to the order of the day.

In the last century France especially was rich in circle-squarers. We will mention: Oliver de Serres, who by means French quadrators of the Eighteenth Century. of a pair of scales determined that a circle weighed as much as the square upon the side of the equilateral triangle inscribed in it, that therefore they must have the same area, an experiment in which $\pi = 3$; Mathulon, who offered in legal form a reward of a thousand dollars to the person who would point out an error in his solution of the problem, and who was actually compelled by the courts to pay the money; Basselin, who believed that his quadrature must be right because it agreed with the approximate value of Archimedes, and who anathematised his ungrateful contemporaries, in the confidence that he would be recognised by posterity; Liger, who proved that a part is greater than the whole and to whom therefore the quadrature of the circle was child's play; Clerget, who based his solution upon the principle that a circle is a polygon of a definite number of sides, and who calculated, also, among other things, how large the point is at which two circles touch.

Germany and Poland also furnish their contingent to the army of circle-squarers. Lieutenant-Colonel Corsonich pro- Germany and Poland. duced a quadrature in which π equalled $3\frac{1}{8}$, and promised fifty ducats to the person who could prove that it was incorrect. Hesse of Berlin wrote an arithmetic in 1776, in which a true quadrature was also "made known," π being exactly equal to $3\frac{1}{4}$. About the same time Professor Bischoff of Stettin defended

a quadrature previously published by Captain Leistner, Preacher Merkel, and Schoolmaster Böhm, which made π *implicite* equal to the square of $\frac{3}{2}$, not even attaining the approximation of Archimedes.

From attempts of this character are to be clearly distinguished
Constructive approximations. constructions of approximation in which the inventor
Euler. Kochansky. is aware that he has not found a mathematically exact construction, but only an approximate one. The value of such a construction will depend upon two things—first, upon the degree of exactness with which it is numerically expressed, and secondly on the fact whether the construction can be more or less easily made with ruler and compasses. Constructions of this kind, simple in form and yet sufficiently exact for practical purposes, have for centuries been furnished us in great numbers. The great mathematician Euler, who died in 1783, did not think it out of place to attempt an approximate construction of this kind. A very simple construction for the rectification of the circle and one which has passed into many geometrical text books, is that published by Kochansky in 1685 in the *Leipziger Berichte*. It is as follows: “Erect upon the diameter of a circle at its extremities perpendiculars; with the centre as vertex, mark off upon the diameter an angle of 30° ; find the point of intersection with the perpendicular of the line last drawn, and join this point of intersection with that point upon the other perpendicular which is at a distance of three radii from the base of the perpendicular. The line of junction thus obtained is then very approximately equal to one-half of the circumference of the given circle.” Calculation shows that the difference between the true length of the circumference and the line thus constructed is less than $\frac{3}{100000}$ of the diameter.

Although such constructions of approximation are very interesting in themselves, they nevertheless play but a
Inutility of constructive approximations. subordinate rôle in the history of the squaring of the circle; for on the one hand they can never furnish greater exactness for circle-computation than the thirty-five decimal places which Ludolf found, and on the other hand they are not adapted to advance in any way the question whether the exact quadrature of the circle with ruler and compasses is possible.

The numerical side of the problem, however, was considerably advanced by the new mathematical methods perfected by Newton and Leibnitz, commonly called the differential and the integral calculus. And about the middle of the seventeenth century, some time before Newton and Leibnitz represented π by series of powers, the English mathematicians Wallis and Lord Brouncker, Newton's predecessors in a certain sense, succeeded in representing π by an infinite series of figures combined by the first four rules of arithmetic. A new method of computation was thus opened. Wallis found that the fourth part of π is represented more exactly by the regularly formed product

$$\frac{3}{2} \times \frac{4}{3} \times \frac{3}{4} \times \frac{4}{3} \times \frac{3}{4} \times \frac{4}{3} \times \frac{3}{4} \times \frac{4}{3} \times \text{etc.}$$

the farther the multiplication is continued, and that the result always comes out too small if we stop at a proper fraction but too large if we stop at an improper fraction. Lord Brouncker, on the other hand, represents the value in question by a continued fraction in which all the denominators are equal to 2 and the numerators are odd square numbers. Wallis, to whom Brouncker had communicated his elegant result without proof, demonstrated the same in his "Arithmetic of Infinites."

The computation of π could hardly be farther advanced by these results than Ludolf and others had carried it, though of course in a more laborious way. However, the series of powers derived by the assistance of the differential calculus of Newton and Leibnitz furnished a means of computing π to hundreds of decimal places.

Gregory, Newton, and Leibnitz next found that the fourth part of π was equal exactly to

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \frac{1}{13} - \dots$$

Other
calculations.

if we conceive this series, which is called the Leibnitzian, indefinitely continued. This series is indeed wonderfully simple, but is not adapted to the computation of π , for the reason that entirely too many members have to be taken into account to obtain π accurately to a few decimal places only. The original formula, however, from which this series is derived, gives other formulas which

are excellently adapted to the actual computation. This formula is the general series:

$$\alpha = a - \frac{1}{3}a^3 + \frac{1}{5}a^5 - \frac{1}{7}a^7 + \dots,$$

where α is the length of the arc that belongs to any central angle in a circle of radius 1, and where a is the tangent to this angle. From this we derive the following:

$$\begin{aligned} \frac{\pi}{4} &= (a + b + c + \dots) - \frac{1}{3}(a^3 + b^3 + c^3 + \dots) \\ &\quad + \frac{1}{5}(a^5 + b^5 + c^5 + \dots) - \dots, \end{aligned}$$

where $a, b, c \dots$ are the tangents of angles whose sum is 45° . Determining, therefore, the values of $a, b, c \dots$, which are equal to small and easy fractions and fulfil the condition just mentioned, we obtain series of powers which are adapted to the computation of π . The first to add by the aid of series of this description additional decimal places to the old 35 in the number π was the English arithmetician Abraham Sharp, who following Halley's instructions, in 1700, worked out π to 72 decimal places. A little later Machin, professor of astronomy in London, computed π to 100 decimal places; putting, in the series given above, $a = b = c = d = \frac{1}{5}$ and $e = -\frac{1}{239}$, that is employing the following series:

$$\begin{aligned} \frac{\pi}{4} &= 4 \cdot \left[\frac{1}{5} - \frac{1}{3 \cdot 5^3} + \frac{1}{5 \cdot 5^5} - \frac{1}{7 \cdot 5^7} + \dots \right] \\ &\quad - \left[\frac{1}{239} - \frac{1}{3 \cdot 239^3} + \frac{1}{5 \cdot 239^5} - \dots \right] \end{aligned}$$

In the year 1819, Lagny of Paris outdid the computation of Machin, determining in two different ways the first 127 decimal places of π . Vega then obtained as many as 140 places, and the Hamburg arithmetician Zacharias Dase went as far as 200 places. The latter did not use Machin's series in his calculation, but the series produced by putting in the general series above given $a = \frac{1}{5}$, $b = \frac{1}{5}$, $c = \frac{1}{5}$. Finally, at a recent date, π has been computed to 500 places.

The computation to so many decimal places may serve as an illustration of the excellence of the modern method as contrasted with those anciently employed, but otherwise it has neither a theoretical nor a practical value. That the computation of π to say 15

decimal places more than sufficiently satisfies the subtlest requirements of practice may be gathered from a concrete example of the degree of exactness thus obtainable. Imagine a circle to be described with Berlin as centre, and the circumference to pass through Hamburg; then let the circumference of the circle be computed by multiplying its diameter with the value of π to 15 decimal places, and then conceive it to be actually measured. The deviation from the true length is so large a circle as this even could not be as great as the 18 millionth part of a millimetre.

Idea of exactness obtainable with the approximate values of π .

An idea can hardly be obtained of the degree of exactness produced by 100 decimal places. But the following example may possibly give us some conception of it. Conceive a sphere constructed with the earth as centre, and imagine its surface to pass through Sirius, which is 134½ million million kilometres distant from us. Then imagine this enormous sphere to be so packed with microbes that in every cubic millimetre millions of millions of these diminutive animalcula are present. Now conceive these microbes to be all unpacked and so distributed singly along a straight line, that every two microbes are as far distant from each other as Sirius from us, that is 134½ million million kilometres. Conceive the long line thus fixed by all the microbes, as the diameter of a circle, and imagine the circumference of it to be calculated by multiplying its diameter with π to 100 decimal places. Then, in the case of a circle of this enormous magnitude even, the circumference thus calculated would not vary from the real circumference by a millionth of a millimetre.

This example will suffice to show that the calculation of π to 100 or 500 decimal places is wholly useless.

Before we close this chapter upon the evaluation of π , we must mention the method, less fruitful than curious, which Professor Wolff of Zurich employed some decades ago to compute the value of π to 3 places. The floor of a room is divided up into equal squares, so as to resemble a huge chess-board, and a needle exactly equal in length to the side of each of these squares, is cast haphazard upon the floor. If we calculate, now, the probabilities of the needle so falling as to lie wholly within

Professor Wolff's curious method.

one of the squares, that is so that it does not cross any of the parallel lines forming the squares, the result of the calculation for this probability will be found to be exactly equal to $\pi - 3$. Consequently, a sufficient number of casts of the needle according to the law of large numbers must give the value of π approximately. As a matter of fact, Professor Wolff, after 10000 trials, obtained the value of π correctly to 3 decimal places.

Fruitful as the calculus of Newton and Leibnitz was for the evaluation of π , the problem of converting a circle into a square having exactly the same area was in no wise advanced thereby. Wallis, Newton, Leibnitz, and their immediate followers distinctly recognised this. The quadrature of the circle could not be solved; but it also could not be proved that the problem was insolvable with ruler and compasses, although everybody was convinced of its insolubility. In mathematics, however, a conviction is only justified when supported by incontrovertible proof; and in the place of endeavors to solve the quadrature there accordingly now come endeavors to prove the impossibility of solving the celebrated problem.

The first step in this direction, small as it was, was made by the French mathematician Lambert, who proved in the year 1761 that π was neither a rational number nor even the square root of a rational number; that is, that neither π nor the square of π can be exactly represented by a fraction the denominator and numerator of which are whole numbers, however great the numbers be taken. Lambert's proof showed, indeed, that the rectification and the quadrature of the circle could not be possibly accomplished in the particular way in which its impossibility was demonstrated, but it still did not exclude the possibility of the problem being solvable in some other more complicated way, and without requiring further aids than ruler and compasses.

Proceeding slowly but surely it was next sought to discover the essential distinguishing properties that separate problems solvable with ruler and compasses, from problems the construction of which is elementarily impossible, that is by solely employing the postulates. Slight reflection showed,

Mathematicians
now seek to prove
the insolubility
of the problem.

Lambert's contri-
bution.

The conditions of
the demonstra-
tion.

that a problem elementarily solvable, must always possess the property of having the unknown lines in the figure relating to it connected with the known lines of the figure by an equation for the solution of which equations of the first and second degree alone are requisite, and which may be so disposed that the common measures of the known lines will appear only as integers. The conclusion was to be drawn from this, that if the quadrature of the circle and consequently its rectification were elementarily solvable, the number π , which represents the ratio of the unknown circumference to the known diameter, must be the root of a certain equation, of a very high degree perhaps, but in which all the numbers that appear are whole numbers; that is, there would have to exist an equation, made up entirely of whole numbers, which would be correct if its unknown quantity were made equal to π .

Since the beginning of this century, consequently, the efforts of a number of mathematicians have been bent upon proving that π generally is not algebraical, that is, Final success of
Prof. Lindemann. that it cannot be the root of any equation having whole numbers for coefficients. But mathematics had to make tremendous strides forward before the means were at hand to accomplish this demonstration. After the French Academician, Professor Hermite, had furnished important preparatory assistance in his treatise "*Sur la Fonction Exponentielle*," published in the seventy-seventh volume of the "*Comptes Rendus*," Professor Lindemann, at that time of Freiburg, now of Königsberg, finally succeeded, in June 1882, in rigorously demonstrating that the number π is not algebraical,* thus

*For the benefit of my mathematical readers I shall present here the most important steps of Lindemann's demonstration, M. Hermite in order to prove the transcendental character of

$$e = 1 + \frac{1}{1} + \frac{1}{1.2} + \frac{1}{1.2.3} + \frac{1}{1.2.3.4} + \dots$$

developed relations between certain definite integrals (*Comptes Rendus* of the Paris Academy, Vol. 77, 1873). Proceeding from the relations thus established, Professor Lindemann first demonstrates the following proposition: If the coefficients of an equation of n th degree are all real or complex whole numbers and the n roots of this equation z_1, z_2, \dots, z_n are different from zero and from each other it is impossible for

$$e^{z_1} + e^{z_2} + e^{z_3} + \dots + e^{z_n}$$

supplying the first proof that the problems of the rectification and the squaring of the circle, with the help only of algebraical instruments like ruler and compasses are insolvable. Lindemann's proof appeared successively in the Reports of the Berlin Academy (June, 1882), in the "Comptes Rendus" of the French Academy (Vol. 115. pp. 72 to 74), and in the "Mathematischen Annalen" (Vol. 20. pp. 213 to 225).

"It is impossible with ruler and compasses to construct a square equal in area to a given circle." These are the words of the final determination of a controversy which is as old as the history of the human mind. But the race of circle-squarers, unmindful of the verdict of mathematics, that most infallible of arbiters, will never die out so long as ignorance and the thirst for glory shall be united.

HERMANN SCHUBERT.

to be equal to $\frac{a}{b}$, where a and b are real or complex whole numbers. It is then shown that also between the functions

$$e^{rz_1} + e^{rz_2} + e^{rz_3} + \dots + e^{rz_n},$$

where r denotes an integer, no linear equation can exist with rational coefficients variant from zero. Finally the beautiful theorem results: If z is the root of an irreducible algebraic equation the coefficients of which are real or complex whole numbers, then e^z cannot be equal to a rational number. Now in reality $e^{\pi\sqrt{-1}-1}$ is equal to a rational number, namely, -1 . Consequently, $\pi\sqrt{-1}$, and therefore π itself, cannot be the root of an equation of n th degree having whole numbers for coefficients, and therefore also not of such an equation having rational coefficients. The property last mentioned, however, π would have if the squaring of the circle with ruler and compasses were possible.

THE CRITERION OF TRUTH.

A DISSERTATION ON THE METHOD OF VERIFICATION.

MODERN science rests upon the recognition of the truth that all knowledge is a statement of facts. The formulation of natural laws is nothing but a comprehensive description of certain kinds of natural processes. Natural laws are generalisations of facts. Similarly, any philosophical theory is, or from the modern standpoint ought to be, simply a systematised representation of facts. Facts are the bottom-rock to which, everywhere, we have to go down.

The recognition of this maxim is called, most appropriately, positivism; and I take it that as a matter of principle all modern thinkers can and perhaps do agree to it. A Roman Catholic philosopher may consider some things as facts which a scientist of heretic England, for instance, does not; yet it is from facts, or what is thought to be facts, that every one derives his conception of the world.

It is natural that the range of individual experience should be very limited in comparison with the knowledge indispensably needed for acquiring an adequate conception of the world in which we live. We have, to a great extent, to rely on statements of facts which we ourselves have not observed. To enrich and to enlarge our own experience we have to imbibe the experience of others. Sometimes we can, but sometimes we cannot, verify what we have been told. For instance, that stones fall through empty space with a velocity of 32·18 English feet at the end of the first second can be verified by experiment, i. e., the experiment can be repeated under the same circumstances. But historical data such as whether Buddha died under a fig-tree, or whether Christ was crucified under

Pontius Pilate, cannot be verified by experiment. Historical data are statements, not of general truths, but of single facts, which, if they are accepted at all, have to be taken on authority. The authority may be weak or strong; it may be strong enough to be equivalent practically to a certainty, which latter case occurs, for instance, when the fact in question in its direct consequences perceptibly affects our life, and its causal connection can thus be directly and indubitably traced.

It is not intended here to emphasise the difference between facts verifiable by experiment, and historical facts; yet it is desirable with reference to all kinds of facts stated on authority, to understand the importance of a criterion of truth. We do accept and we have to accept, every one of us, without any exception, the most discriminate scientist even and most of all the philosopher, innumerable statements of facts as they have been observed by others. We all have to rely on the authority of others. The time of the longest human life would be too short to repeat all the experiments made by others, with a view to verifying them in detail. On the other hand, it is obvious that no statement of facts should be accepted on pure authority. We must have a means, a sieve as it were, by which the wheat can easily be winnowed from the chaff; a sieve that will enable us to discard at once those statements that are positively erroneous. In this way our attention can be confined to statements of things that are possible, those that need not, but *may* be true. "Possible" in German is very appropriately called *möglich*, i. e. *mayable*.

The criterion of that which 'may be' true is the first step towards ascertaining truth; and although it does not exhaust the methods of arriving at truth it is of greatest consequence, for if properly understood and applied, it would save from the start many useless efforts in the investigation of truth.

* *

The question arises then, What is the criterion of the possible? We reject statements, sometimes, as *prima facie* untrue. Have we a right to do so? And if we have, by what standard do we determine this?

Let us first take into consideration how people really behave when a statement of new facts is made. Take, for instance, the following case. Two strangers meet; A. and B. Mr. A. relates to Mr. B. some incident of his life. He is apparently a very trustworthy person and during the conversation remains perfectly serious. He tells a ghost story in detail, how a departed friend of his appeared to him in distinctly visible form; he says that the spirit spoke to him and told him many strange things, and that he pointed out to him an imminent danger.

We suppose that on the one hand A. makes his statement in good faith and that on the other hand B. is a spiritualist. Will B. consider A.'s story as possible? B., being a spiritualist, most probably will consider A.'s story as possible, and, if he is convinced of A.'s honesty, he will believe the story the same as if he had experienced it himself; no less than a scientist will rely on the statement of an experiment made by one of his colleagues whose scientific veracity he has no reason to doubt.

Suppose A. tells the same story to C. Mr. C. is an infidel and a materialist. As characteristic features of his personality we might mention that he considers religion as pure superstition originated by the fraud of cunning priests. This man will, we may fairly suppose, laugh at A.'s story, because it appears to him an out and out lie. Mr. A. as well as Mr. B., he who tells and he who believes the story, C. will declare, are either insane or they are both impostors.

The difference of opinion in B. and C. indicates that the criterion of truth is different with different persons and that it depends upon their conception of the world. Men who have the same world-conception will also have the same criterion of truth.

The problem consequently is, whether this criterion of truth (i. e. the criterion of what is possible) is necessarily wholly subjective, or whether we can arrive at an objective criterion. It is apparent that this question is intimately connected with another problem, namely, Is every world-conception necessarily subjective, or, Is it possible to arrive at an objective world-conception? It appears to me that we can; and the ideal of philosophy to-day is just such an objective representation of facts.

The difficulty that presents itself lies mainly in the confusion between facts and our interpretation of facts. If A. declares that he saw a ghost, he does not relate a fact, but his interpretation of a fact. Let us suppose that he tells his story again to a third person D., who is a psychologist. D. most likely will not think him a liar. D. will accept the statement *bona fide* as a mere interpretation of a fact and will inquire after the causes that produced the hallucination. He may be able, possibly, to lay bare the facts disfigured by the wrong interpretation of A. And having clearly stated the objective state of things he may with the assistance of his experience explain the origin of the whole process, partly from the mental condition and the physiological constitution of A., partly from individual circumstances that gave rise to the hallucination. He will not doubt that something extraordinary has happened to Mr. A. The latter's mind has been, and perhaps still is in an abnormal state. And as to B.'s believing the ghost story, Mr. D. will not think that he is insane; though we may presume that he will regard B.'s views of the world as resting upon unfirm grounds; and he will not believe him to be a man of critical ability.

The notion is very common among idealists that we can never go beyond our subjective states of consciousness. This would be tantamount to saying that there is no difference between dreams and real life, except that a dream is cut off by awaking while life lasts comparatively much longer and ceases with death, which may also be an awakening from a dream. In that case hallucinations would be of the same value as sensations. Both would be interpretations of facts for which we do not have an objective criterion of truth. Interpretations of facts would be the sole facts, and it would be quite indifferent whether they were misinterpretations or correct interpretations.

Take a simple instance. We see a tree. The perception of a tree is an interpretation of a set of facts. Interpretations of facts, whether correct or not, are of course also facts. Thus the perception of a tree is a fact which, if all matter were transparent, would, physiologically considered, appear to the eye of an observer as special vibrations in the brain. But the peculiarity of this fact is that

it represents other facts. The question is no longer whether there is a perception of a tree taking place in a brain, but whether this perception is true, i. e., whether it agrees with the facts represented. Every perception has a meaning beyond itself; every perception is a fact representing other facts, and the question of truth or untruth has reference to the agreement between representations and facts represented.

Professor Mach says in his essay "The Analysis of Sensations" (*The Monist*, Vol. I. No. 1, p. 65):

"Bodies do not produce sensations, but complexes of sensations (complexes of elements) form bodies."*

And, certainly, we do not deny that upon a closer analysis the perception of a tree appears as a bundle, or a complex of sensations; there is the green of the leaves, the color of the bark, the different shades of the color indicating its bodily form, the shape of the branches, and their slight motions in the breeze that gently shakes the tree. Yet the perception of a tree does not consist of these sensations alone. All these sensations might be so many isolated sensations; and if they remained isolated, they would not produce the percept of a tree. These sensations are interpreted; they have acquired a meaning and are combined into a unity. It is this unity which constitutes the perception of a tree. This unity has grown from sensations; and that process which develops and, as we have learned, naturally must develop sensations from sense-impressions, and from sensations perceptions that are representative of a group of facts outside of the perceptions themselves,—that process we define as mind-activity.

What does the 'perception of a tree' mean? It means that if the person perceiving it moves in a certain direction and over a certain distance, he will have certain sensations which upon the whole can be correctly anticipated. Every perception and also every sensation contains a number of anticipations. The perception

*Professor Mach in thus speaking of bodies uses the word in the sense of representations and not in the sense of objects represented. He calls them in the sentence next following "thought-symbols for complexes of sensations (complexes of elements)."

of a tree is in so far to be considered correct, as the anticipations which it contains, and of which it actually consists, can be realised. If and in so far as these anticipations when realised tally with the perception, if and in so far as they justify it, or can justify it, if and in so far as they fulfil the expectations produced by the perception, if and in so far as they make no alteration of the perception necessary, but being in agreement with it confirm the representation it conveys: the perception is said to be true. Moreover, we can predict similar results with regard to beings of a similar constitution.

* * *

Now let us suppose that an apple falls from a considerable height to the ground. Knowing, from former experiences, the hardness of the soil as well as the density of the apple, we can anticipate the effect of the fall. The soil will not show any considerable impression, yet one side of the apple will be crushed. In predicting this result we anticipate sensations that we shall have under a certain set of circumstances. In so far as we shall necessarily have these sensations we have to deal with facts. Not as if our sensations constitute the entire existence of facts; our sensations, being the effects of so-called objective processes upon our senses, are only one end of a relation, which as a matter of course never exists without the other end. Sensations are the one end; they depend upon and vary with the other end. Showing within certain limits as many varieties here as occur there, they represent the other end.

We can, and for certain purposes we must, entirely eliminate the subjective and sensory part of our sensations, in order to represent in our minds not how two objects affect our senses of sight or touch but how two or more objects affect each other. Thus we arrive at an objective statement of facts, how the falling apple affects the soil, and the soil the apple; while the relation of both to our senses is to be eliminated. This objective statement of facts is the ideal of all natural sciences. The physicist states the interaction between the falling apple and the soil. He does not care how many sentient beings witness the fall; he does not care about the psychological element in their observations. He abstracts from the subjective ele-

ments in their observations as well as in his own, and confines his attention to the objective facts represented in their minds.

The objection to this conception of things is made by a consistent idealist, that these observations must always exist in some mind, they do not exist outside of a mind, and mind can as little go beyond itself as a person can walk outside of his skin. Certainly, observations always exist in some mind; they have always a subjective element. But they have also an objective element. No sensation, no perception, no observation is without an objective feature. This objective feature in a sensation or a perception, and also in an abstract idea, is the element that if true has to agree with other facts outside of the sentient being of whose mind the perception is a part. An idealist who is pleased to deny this would either have to identify hallucinations with sensations, or he would be obliged to consider the objective elements of his mind merely and solely as subjective states, having no representative value. In that case he would necessarily be obliged to consider the facts represented, i. e. the things outside the body, as parts of his mind. This being granted, every mind would appear as congruent and coextensive with the universe. We should have as many universes as there are minds, and yet all universes would be only one and the same universe, their sole difference being that of a difference of centres. With the death of every living creature a universe would die; but notwithstanding the chain of consciousness were broken forever in death, the existence of his mind, being that which is commonly considered as the objective universe, would not cease; merely a view-centre would be lost. That which we have characterised as representations in feeling-substance (which according to our terminology constitutes mind) would be a transient and unessential feature of mind only; and if it should cease to be, mind would still exist in what we have defined as the outside facts, the facts represented in mental symbols. In short, mind would be the All, it would be a synonym of God. And not only all mental beings actually existing or having existed would each, one and all, constitute the universe, but also all potential minds, every atom and all possible combinations of atoms that possibly might

play a part in the mental activity of a sentient being, would constitute it.

The views of an idealist who accepts these consequences are undeniably correct, although we may quarrel about the propriety of his terminology. Yet an idealist of this type, we may fairly assume, will have little difficulty in adapting himself to our terminology, and in that case we might easily agree about the possibility of arriving at a criterion of truth; for his world-conception (aside from a difference in terms) might, or rather would be practically the same as ours.

If truth is the agreement of certain mental facts with other facts outside of the mind—if it is the agreement of subjective representations with objective things or states of things represented, the problem is whether we have any means of revising or examining this agreement.

* * *

If the world were a chaos, i. e. if the facts of nature were not ruled by law; if every fact were not only individually but also generically different from every other fact, so that no single fact had anything in common with other facts; if they thus had no features in common, there would exist no general properties, and we could form no concepts of *genera*; facts would vary radically and totally, without exhibiting regularities or uniformities other than such as might occasionally and without any reason incidentally originate by haphazard,—in short, if our world were a world of chance and not of law, there would be no criterion of truth. Our world, however, is a world of law and not of chance. Thus all facts, although individually different, are found generically to agree among themselves. No two atoms are, with regard to their position, the same at a given moment; all of them are different somehow in their operation and effectiveness. Nevertheless every one of them moves in strict accordance with exactly the same law of causation. There is not the least change taking place in the universe which is not the precise effect of a special cause. There is rigidity in mutability, unity in variety, determinateness in irregularity, law in freedom, order in anarchy. The unity of law, which in its oneness is comprised in the

universality of causation, is so perfect that the different facts cannot be thought of as being generically different. However much they differ specifically, they represent the action of the same law, and this same oneness of nature is the basis of all monism.

Monism of this kind, it has been remarked by a critic of ours,* is identical with philosophy. Certainly it is. Every philosophy is or at least attempts to be monism, and in so far only as a philosophy recognises monism does it possess a criterion of truth. This monism may be based upon a correct or a mistaken conception of unity. Upon the correctness of this monism will depend the correctness of the criterion of truth. But it must be understood that without a monism there can be no criterion of truth, and philosophy must become either scepticism, mysticism, or agnosticism.

What then is the criterion of truth for a single fact, be it a sensation, a perception, or an observation? It is this, that if the observation be repeated under the same circumstances it will, to the extent that the circumstances are the same, be again the same; the observer will always make the same observation.

This maxim will do for a statement of facts. If according to this maxim we are in the position to ascertain that the same observation can be made again and again under certain conditions, we gain the assurance that we have to deal with a fact of some kind. But how shall we inquire into the correctness of the interpretation of the fact?

* * *

Every living creature and furthermore among human beings every individual man has an idiosyncrasy of his own. How can we

* *The Nation* quotes the following passage from a former essay of mine: "The philosophy of the future will be a philosophy of facts, it will be *positivism*; and in so far as a unitary systematisation of facts is the aim and ideal of all science, it will be *monism*." *The Nation* rejects this definition of monism and adds: "The search for a unitary conception of the world or for a unitary systematisation of science would be a good definition of *philosophy*; and with this good old word at hand we want no other."

Very well. Call that which we call monism or a unitary systematisation of knowledge, "*philosophy*"; we will not quarrel about names—*dummodo conveniamus in re*. We agree perfectly with our critic; for we also maintain that monism (at least, what we consider monism) is philosophy; it is *the* philosophy.

avoid the errors arising therefrom? We substitute other observers so that we can detect to what extent the individual way of observation influences the result of the experiment. Thus we shall find that some persons are color-blind with reference to red or to green, and we can in this way explain certain mistakes caused by such conditions.

Supposing that all human beings were color-blind we should consider this state as normal; and the discovery of science that certain colors which appear alike to us, are after all, considering their wave-lengths and other qualities, more different than certain other tints which are easily discerned by the eye, would be an unexpected surprise. It would to some extent be analogous to the well-known fact that there are rays of light which are not perceptible to the eye, namely, the so-called chemical rays; their existence has been discovered by their chemical effects.

It might be, although it is not probable, that what appears green to me and what I call green, may appear different to other people, perhaps gray, red, or brown, or some other color that I know not of: yet other people will—just as much as I do—call that peculiar sensation green which they experience under the same conditions, for instance, when seeing the fresh leaves of a tree. It is quite indifferent how variegated in single minds the feelings may be that accompany each kind of sensation. So long as they have for every special objective state a special analogue, they can map out in their minds their surroundings, they can have a correct representation of the world, and so long as they employ the same symbols (words or other signs) for indicating the same objective states, it is quite indifferent whether or not the feelings that are produced in the process of observation vary. It would make no more difference for the general purpose of mental operations, than it would if we were to employ Roman letters, or Italics, or Greek or Hebrew characters to designate the lines and points in explaining a mathematical figure. The main thing is that certain points are marked and represented by some sign which stands for this or that point and for that alone.

To cite another example in illustration of the subjective ele-

ment of feeling in cognition, we may compare our knowledge of the world to the map of a city. The map may be printed in black, green, red, blue, or any other color. The color in which the map is printed represents the subjective element of feeling, while the form of the lines, their geometrical configuration, contains the objective element of the things represented. The map is good, i. e. its representations are true, if the squares and the streets of the city stand in the same relation among each other, as the little blocks and divisions on the map do. Whether the map is printed in green or blue will make no difference so long as we find everything we want to know about the city represented in a way such that we should be able to set ourselves aright and to find our bearings if we went astray.

The subjective element in mind is not of one half the importance generally attributed to it. The objective element, being that which is represented, is paramount, and it is the aspiration of all the sciences to concentrate their entire attention upon the objective features of observation. Objective truth is what we want, and objective truth is identical with a scientific description of facts.

* * *

What then is the criterion of objective truth for the interpretation of facts? Is it not wanting? May it not be that a person, Mr. A., will under given circumstances regularly see a ghost. Indeed we do not doubt that he will, and we can even prove it by experiment. This being so, is not the interpretation of facts as to whether the phenomenon is a real ghost or a mere vision, beyond any criterion of truth?

If the methods of science are reliable, (and they have been justified by their brilliant success,) we have indeed a criterion for the interpretation of facts; and this criterion for the interpretation of facts, no less than the criterion of single observations is based upon monism. If the world is really a universe, if there is oneness in the All, if there is a unity of law throughout nature, our interpretations of the different facts must agree among themselves. They cannot and should not contradict one another; and whenever they do, it is

a certain sign that somewhere there is something wrong in our interpretation of facts.

Philosophy has ceased to be a metaphysical world-theory. The interpretation of facts no longer means a hypothetical assumption which will square all the irregularities among facts that we are unable to account for, but simply a methodical systematisation of facts, enabling us to recognise the sameness of law in the irregularities apparent in innumerable individual instances. Interpretation in this sense means harmonisation ; it means an orderly arrangement ; classification with due discrimination. An explanation of natural phenomena is not the carrying of an hypothesis into facts out of the realms of our imagination, out of depths unknown, by what might be styled revelation or inspiration, but it is a comparison of facts with facts. The hypothesis we apply to facts must come from facts and must cover facts. That element in an hypothesis which does not cover facts is redundant as an explanation ; it is useless as such, or even dangerous ; and unless it serves as an aid to thought where ignorance of facts requires some assistance, some allegorical symbol, some auxiliary construction,—unless it is to the scientist what crutches are to the lame,—it must be dropped.

Accordingly, the criterion of truth is the perfect agreement of all facts, of all interpretations and explanations of facts among themselves. If two facts (such as we conceive them) do not agree with each other, we must revise them ; and it may be stated as a matter of experience, that our mind will find no peace until a monistic conception is reached. A monistic conception is the perfect agreement of all facts in a methodical system, so that the same law is recognised to prevail in all instances, and the most different events are conceived as acting under different conditions yet in accord with the same law.

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It does not lie within the scope of this essay to enter upon the practical application of the principle which we have set forth as the criterion of truth. One hint only may be supplied, to point out the most obvious maxim derivable from it—a maxim that is instinctively

obeyed by all scientists and has often been popularly expressed in the sentence: An ounce of fact is worth a hundred pounds of hypothesis, or of any interpretation of facts. All the theories in the world, scientific and economical, our dearest ideals not excepted, and all the most ingenious hypotheses have no value unless they have been derived from, and agree with, the laws that live in the facts of our experience.

The trouble of applying this rule lies mainly in the difficulty of distinguishing between facts and our interpretation of facts. Considering that mind is representativeness in feelings we have to analyse the mind in order to come down to objective facts. The percept of a tree is not the tree; it is an interpretation of a group of facts; it is a mental picture produced by a synthesis of sensations, the latter being caused by sense-impressions. Considering that all the images, ideas, abstract concepts, and theories of which our mind consists are not the facts represented by them but their several interpretations, we at once see how careful we have to be for purposes of philosophical and scientific exactness in the statement of facts.

* * *

On this occasion, a few critical remarks concerning the leading essay of this number, "The Architecture of Theories," by Mr. Charles S. Peirce, may be added. Mr. Peirce is one of our subtlest thinkers and logicians, and it is incumbent upon one to reflect twice before criticising any sentence of a man who writes upon the most recondite topics,—upon what I should call the higher mathematics, the differential and integral calculus of logic,—with ease and masterly accuracy. Mr. Peirce's essay "The Architecture of Theories,"* presented in this number of *The Monist*, is the first publication of his in which he propounds not mere criticism or the

* The term "architecture of theories" seems inappropriate from the standpoint of a positive conception of the world. Many monisms have been constructed in the way Mr. Peirce so well describes in his comparison of these philosophical systems to the building a house of one and the same material, for instance *papier mâché*, with roof of roofing paper, foundations of paste-board, windows of paraffined paper, etc., etc. Philosophy, however, is not a construction of a theory comparable to the building of an edifice; it is rather the mapping out of the house in which we live for the purpose of orientation.

discussion of abstruse logical subjects, but his own positive opinion, presenting in great and clear outlines the foundations of his philosophy.

The world-conception of Mr. Peirce agrees in one fundamental maxim with our own, but it disagrees with the latter in the main and most important application of this maxim. Mr. Peirce says, "Law is *par excellence* the thing that wants a reason." This maxim was the guiding star of our inquiry into the fundamental problems of philosophy.* The world considered as a universe displaying in all its innumerable actions one and the same law is called a cosmos; if considered as a heap of processes with no common law pervading them it is called a chaos. We found in our inquiry into the forms of existence that the laws of form possess intrinsic necessity. The laws of the form of existence are represented in the laws of formal thought (arithmetic, mathematics, logic, mechanics, and pure natural science). So long as the formal laws hold good, (and we have found in the chapter "Form and Formal Thought" that they will hold good under all circumstances,) any kind of world, whatever materially or dynamically it be, must be a cosmos, and cannot be a chaos. We can imagine that we had a world consisting of some other substance and being different either in the amount or in the action of its energy to this world of ours, but we cannot imagine that a world should exist which does not exhibit the harmony of form, and is not regulated as it were by the formal laws of existence. One plus one would be two in any kind of a world, and obviously all the other more complex statements of formal laws would remain true with the same intrinsic necessity. The truth 'one plus one makes two' contains the universal applicability of causation and of the conservation of matter and energy. Taking this ground we arrived at the conclusion that the world is a cosmos: there is no chaos and there never has been a chaos. A chaos, in the sense of an absolute non-existence of law, is an impossibility.

Accordingly, we cannot agree with Mr. Peirce that the occurrence of chance "calls for no particular explanation." There is no

* See the author's *Fundamental Problems*.

chance, if chance means absence of law. Chance, if the word be admissible, is a mere subjective conception produced by limited knowledge and signifying a state of things not determinable with the means of knowledge at our disposal. Law once recognised is the death of chance (in the objective sense of the word); and chance, or sport, or chaos, or indeterminacy, or whatever one may call the absence or at least the imperfect cogency of law, far from "calling for no particular explanation," must be classed *prima facie* among those theories that are *per se* impossible. These conceptions whether applied to the world at large or to special processes of nature are in contradiction to those interpretations and systematised statements of facts which are most fundamental, most reliable, most indispensable and universal. Whatever generalisation the theory of evolution may be capable of, it is certainly not capable of being applied to law. The formal order of Nature and especially the mechanical laws of physics cannot be thought of as having been developed out of a state of sportive chance; they must be considered as having always been the same as they are now: they are eternal.*

In stating this difference of opinion, I apprehend a possibility that although Mr. Peirce has stated his case with most admirable and I should say unequivocal clearness, I have misunderstood his views. In a former article of his, Mr. Peirce makes a statement concerning Nature considered as a possible chaos, which seems to concur rather with my views on the subject than with his own. Mr. Peirce says in his fourth Paper on the "Illustrations of the Logic of Science":

"If there be any way of enumerating the possibilities of Nature so as to make them equally probable, it is clearly one which should make one arrangement or combination of the elements of Nature as probable as another. . . . It would be to assume that Nature is a pure chaos, or chance combination of independent elements, in which reasoning from one fact to another would be impossible; and since, as we shall hereafter see, there is no judgment of pure observation without reasoning, it would be to suppose all human cognition illusory and no real knowledge possible.

* Mr. Peirce seems to define Mind as sportive chance; for according to his theory, as soon as sportiveness assumes fixed habits, it settles into the mechanical motions which physical science observes in gravitating masses; and matter is thus defined as "effete mind."

It would be to suppose that if we have found the order of Nature more or less regular in the past, this has been by a pure run of luck which we may expect is now at an end. Now, it may be we have no scintilla of proof to the contrary, but reason is unnecessary in reference to that belief which is of all the most settled, which nobody doubts or can doubt, and which he who should deny would stultify himself in so doing.

"The relative probability of this or that arrangement of Nature is something which we should have a right to talk about if universes were as plenty as blackberries, if we could put a quantity of them in a bag, shake them well up, draw out a sample, and examine them to see what proportion of them had one arrangement and what proportion another. But, even in that case, a higher universe would contain us, in regard to whose arrangements the conception of probability could have no applicability.

I rest the case here in the hope that the statement of both sides of the problem will contribute to elucidate truth.

EDITOR.

FIVE SOULS WITH BUT A SINGLE THOUGHT.

THE PSYCHOLOGICAL LIFE OF THE STAR-FISH.

THE investigation of the psychical faculties of animals is comparable to a journey into fairy-land. We do not know, and according to Du Bois-Reymond, we shall never know, how our own mental activity has originated, yet in spite of this we deliberately form theories and opinions concerning the psychical powers and faculties of other beings that in point of nervous organisation are perhaps altogether different from us! The ancients wisely limited themselves to expressing the intelligence of animals in the form of instructive fables, and in the famous park of Versailles the charming idea was actually carried out of representing the fables of Æsop in a so-called labyrinth, every turn of the intricate lanes of which led to a different group of animals whose speech was symbolised by streams of water spouting from their mouths, and the purport of their imagined utterances was to be read in golden letters upon marble tablets placed at the side. How often have I wandered over the scene of those long since ruined mazes and have thought of the deep meaning that frequently lies in childish pastime of this kind.

But labyrinth aside—when we see an animal perform before our eyes purposive acts; and we recognise that our own thought operates in accordance with definite, rigorous laws; we shall still have to say to ourselves that a comparative animal psychology is after all not necessarily so hopeless a thing as one might be led to believe from the bold, and yet faint-hearted, “Ignorabimus” of the distinguished Berlin physiologist. And as a matter of fact the range of

insight obtained in very recent times into this very field is highly encouraging. On this occasion I should like to select for discussion one of the most remarkable of questions, that, namely, which concerns the psychical activity of *many-souled* animals.

Quite a stir was made some years ago in the scientific world when Haeckel began to philosophise about the souls of cells, or so-called plastidule-souls; for it was patent that the course of life in the individual single cell of an animal or vegetable body flowed on in such strict conformity with reason that it was logically necessary to posit the presence of psychical guidance in the instance in question as much as in the case of composite cellular colonies in higher organic beings,—especially since every single one of these composite organisms begins its life as a simple cell, from which the others afterward spring. The wide-spread opposition that Haeckel's view met with, must be regarded as the result of current and common ignorance of the history of philosophy; since otherwise it must have been known that the idea of a cell-soul or a germ-soul which controls the development of the young, has been propounded by innumerable philosophers, and that it was proclaimed by Daniel Sennert, of Wittenberg, who died in 1637, with perfect consistency as the foundation of all psychological knowledge. Many beings, such as Algae, Fungi, and Infusoria, never in their lives get beyond the state of a single cell, and yet under the microscope we may observe them seeking light, capturing prey, and in the majority of cases founding families. And when the Genevan Trembley discovered, in 1740, the fact of the divisibility of fresh-water Polyps and showed that after cutting them up every piece grew and developed into a new individual endowed with sensation, will, and other psychical capacities, philosophers began to debate whether there were initially present in every divisible polyp a number of souls in the germinal state, or, if such were not the case, whether the simple soul of a polyp possessed the property of divisibility. The Leipsic theologian Crusius, who died in 1775, declared in favor of the presence in every polyp of a plurality of germinal souls; the Dutch insect anatomist, Peter Lyonnet (died 1796) declared in favor of the divisibility of the single polyp soul.

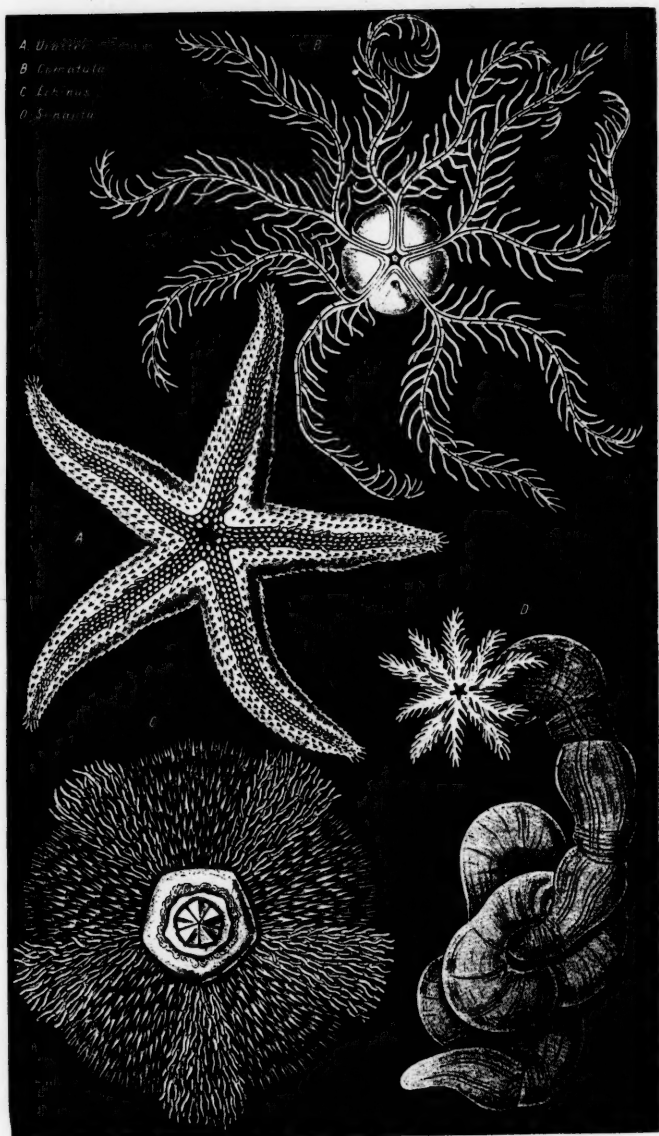


Fig. 1.—STAR-FISH. (After Haeckel.)

But let us pass by these subtle speculations to turn to a class of animals in the case of which we may speak with more propriety than in the case of polyps and other zoöphytes of a plural soul, since physically and psychically they act in every respect as if they had grown together out of five or more individuals,—I mean the Echinoderms in general and the Star-fish (*Asteroidea*) in particular. In the following paragraphs, for the sake of brevity, I shall speak of only five-rayed star-fishes, because the sacred number five is the one that lies at the basis of the physical structure of the great majority of star-fishes developed from the egg, and of all other echinoderms, although there really do occur star-fishes which are supplied, some with more and some with less than five rays,—single rays often being cast off and a larger number growing out in their places,—and although many species are regularly and normally supplied with more than five rays. From visits to the sea-shore or to aquariums, at any rate from pictures, my readers all know how a star-fish in general looks. In the first cut which accompanies this article a number of echinoderms are presented. The star-fish is in the centre to the left. It resembles the decorative star of an Order, and has short or long, broad or slender rays, as the case may be, and a disc-shaped central body.

The observation which is most important for our present discussion, and which strikes us on first seeing a star-fish, or its relatives the sea-urchin and the sea-anemone, consists of the fact that these animals possess no head, which even the most insignificant worm or insect does not lack, and that consequently its organs are in want of a guiding, regulative member, possessing externally organs of sense and having within a brain with the power to communicate the requisite commands for the movement and the conduct of the same. On the contrary, each single branch or ray possesses its own individual nervous system; and in the case of the voluntary separation of the rays, which frequently occurs, is able to continue life of its own independent accord, developing itself by the growth of new rays into a new and complete star-fish. (See Fig. 2.) But these five or more nervous systems do not radiate from a common central nerve-ganglion which might be termed a central

brain, but are merely joined to a nerve-ring which lies in a common central portion, encircling the esophagus; this nerve-ring in the majority of cases forms a regular polygonal figure, and into each angle of the polygon the nerve-cord of a ray enters. It will be seen from this structural arrangement of things, that the psychical and mental guidance of these animals is entrusted to a board of five members who possess, it is true, sentient communication with each other, but act without the intermediation of a presiding officer.



Fig. 2.—COMET-FORM OF ARM OF A STAR-FISH.
A cast-off arm re-forming by the sprouting of four new rays.

We may well look forward with intense interest to the outcome of a psychical administration of this kind, and to tell the truth, until recently its importance has been greatly underestimated. Every inference made with respect to the psychical excitability of an animal must be derived from its movements and actions in various natural and artificially produced positions, by observing what its conduct under these conditions is. To start with, star-fishes, like sea-urchins (which psychically are similarly governed), admit with respect to the position of their bodies a distinction of top and bottom; that is to say, the side on which the mouth lies situated in the centre of the five rays belongs properly face downwards, while the opposite surface is to be regarded as the dorsal side. But the conceptions of a forepart and a hindpart, of a right and a left are not applicable. The rays of the star-fish, like the central disc, also plainly exhibit a distinction of lower and upper parts. Among the real star-fishes (*Asteroidea*) the inferior or ventral surface of the arms is supplied either with two or with four rows of sucker-feet or pedicels, consisting of long, extensile, hollow sacs, which when filled and extended by the water let into their widely ramified ambulacral systems, protrude into the grooves of the arm through openings in the hardened calcareous integument. To level surfaces they easily cling fast by simply drawing back the terminal

discs of their tubular feet and thus creating a rarefied atmosphere in the space between the object to which they adhere and the puffed out walls of the extremities of the pedicels. Star-fishes may be seen climbing in this way, with their hundreds and hundreds of tube-feet, up slippery cliffs and even the perpendicular glass walls of aquariums, and they are even able to hang suspended from a horizontal glass ceiling for a considerable length of time after they have been taken out of the water. When they wish to change their position they do it by alternately loosening and fastening their extensible feet in such a way that those loosened reach forward in one and

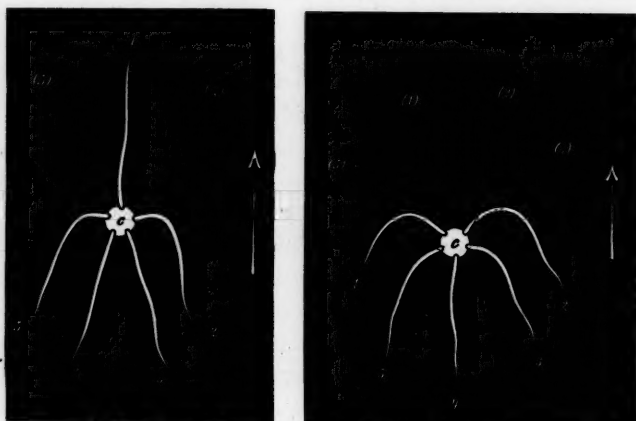


Fig. 3.—MODE OF LOCOMOTION OF SAND-STARS. (After Preyer.)

In the cut to the left *r* first advances, then (*s*) and (*z*); *z* and *q* remaining at rest. Whereupon (*s*) and (*z*) simultaneously come back to the positions *s* and *z*, *c* is lifted and pushed forwards with *r*, while the two rays *z* and *q* are pulled along behind. In the figure to the right the same animal first shoves forward the pairs (*r*) (*z*) and (*s*) (*q*), *q* remaining at rest, and then bends both pairs backwards, dragging only *q* behind; *c* is lifted and thrown forward in the direction of the arrow.

the same direction uniform in all the arms, and fasten themselves to the surface anew, whereupon the others also let loose and go through the same movement in the same direction. The sucker-feet also help to convey to the mouth the food seized at the end of the arms.

While in this instance, accordingly, the arms, although they are not immovable and bend and approach each other, officiate rather as the bearers of organs than as prehensile and locomotory apparatuses themselves,—the sucker-feet performing the principal

tasks and requiring for their work a very finely ramified nervous system; in the case of a certain other division of the star-fishes, the so-called sand-stars (*Ophiuridae*), the arms are thinner and more supple, and act as organs of prehension and locomotion, dispensing more or less entirely with their suckorial pedicels. By alternately thrusting three feet forward (Fig. 3) and then drawing back the two side feet of these three, the five-footed sea-stars move more swiftly than the others, sometimes proceeding by jumps even; but they cannot climb up smooth surfaces, or cliffs, unless irregularities are present which may be grasped by their pliant arms, whereas on the other hand the common star-fishes, which are furnished with sucker-feet, climb best of all on smooth and slippery surfaces, each one of their countless pedicels being able to suspend a considerable weight, in some species as much as twenty-five grammes. In other respects, especially with regard to the ring-shaped connection of the five nerve-cords, their organisation is essentially the same; only in the sand-stars the central portion forms a disc more distinctly separate from the arms, in which former the common organs of feeling and digestion have more fully retracted.

Recognising thus, that the star-fishes and all their relatives act physically like a federal animal-union, composed of five independent animal-states, I called attention in the first edition of my work "Werden und Vergehen" (1876) to the psychological enigma that we were here confronted with a five-fold Siamese monster, as it were, in which five separate persons were brought mentally under the same guidance, or where five minds had to pull, simultaneously, one rope. On account of the absence of a head and a brain in these animals, certain well-known modern animal psychologists have taken the position that their powers of psychical performance are very scanty, and that, in a much fuller sense than was predicated of all animals by the Cartesians, these especially were irrational automata, or, to use a technical expression, were mere "reflex-organisms," animals in which only direct external excitations evoke with unalterable regularity responsive movements, so that, for example, if any unpleasant excitation were brought to bear on them from any direction they would move in the opposite direction, but would ap-

proach if anything became perceptible that excited their desire for food. On this ground the distinguished English animal psychologists Romanes and Ewart claim to have established that these animals actually do respond like machines to external excitations; if they were excited at any part of their body by a wound, by the application of acids, an electric current, or any other irritant, they would run without exception in a straight line in the opposite direction, but if the excitation were applied to any two parts of their body at some distance from each other they would move in the line of the diagonal of the two directions, in accordance with the principle of the parallelogram of forces. Similarly their movements after prey and food (the presence of which at a distance was made known by the emission of odors), their movements toward more brightly illuminated parts of the containing vessel, their flight from the air into the water, their recovery of their normal position when placed on their backs, and finally their so-called autotomy or self-amputation, that is the casting off of their members under the irritation of powerful stimuli—were all held to represent mere automatic responses to prearranged conditions without a trace of intelligence being exhibited.

In view of this condition of things it was a very welcome announcement, that one of the most brilliant representatives of modern experimental physiology and psychology, Professor W. Preyer, at present of Berlin, had determined to undertake a comprehensive series of experiments with these very animals, and was able to carry out his intention at the zoölogical station in Naples, so admirably adapted to the purpose. To obtain clear ideas generally with regard to animal reflex-mechanisms, fitter specimens for experiment could scarcely be presented than the star-fishes, which unite a rare degree of decentralisation, power of independent action, and absence of a cerebral centre, with a nervous system of the minutest ramifications. Here, if anywhere, were simple, clear and transparent results to be expected, and finally information relating to the co-operative activity of different nervous systems. Preyer published the results of his observations in the "*Mittheilungen der Zoologischen Station in Neapel*" for the years 1886 and 1887, and although he does not

regard his labors as completed, the scientific reading public may nevertheless take sufficient interest in the present state of his researches to justify a presentment of the principal and most general results obtained.

In confirmation of the view that previously obtained it was found that these animals actually did respond in a rare degree to given stimuli in a manner determined once for all ; it could be foretold with a degree of sureness verging on astronomical certainty, how, for example, the sucker-feet of a star-fish would act if the animal in its normal and sound condition was irritated at this or that place, powerfully or weakly, one time or many times successively, by mechanical or chemical applications, by electric currents, or heated instruments. With all the means of irritation employed the result was always identical, and consisted in the fact that the distensible feet were drawn in at the point of application when the irritation did not extend beyond its region, no matter whether it was applied at the inferior or superior surface of the animal, but that protrusion of the feet never resulted from local irritations of this character so long as they did not exceed a certain intensity. A more powerful irritation, on the other hand, radiating over a greater portion, or over the whole animal, produces a general protrusion of the distensible pedicels, so far as the irritation extends, with the single exception of the point of application itself when the same lies on the inferior surface.

Inasmuch as this swarming protrusion of pedicels may spread over the entire inferior surface when only a single arm is irritated in the neighborhood of its extremity, it follows from this that the nervous excitation must first be conveyed to the ring at the centre in order to radiate thence to the pedicels of the other arms ; and from the manner in which the irritation is propagated, the course of the radiation can be accurately followed. Thus, if the irritation of an arm proceeded from the dorsal region, the distensible pedicels of this arm were the first to protrude, then those of the two adjacent arms, and finally those of the two remaining arms, but in the latter not quite out to the extremities unless the irritation exceeded a certain intensity. That is to say, the effect of the irritation was prop-

agated through the inner nerve-ring according to the same laws by which a fluid under pressure or an electric current in a similar conductory system would proceed. But if the connection of the ring was severed at both sides of the irritated arm, the effect would remain confined to that arm. If the connection was broken only on one side the irritation advanced round the other side and reached the severed neighbor last. On the other hand, a powerful irritation of the central disc immediately provoked the extension of all the pedicels. The phenomena recorded occurred moreover in accordance with simple mechanical laws as was expected from the outset, and when the irritations were unusually powerful the effect was manifested by a continuous alternate extension and contraction of the pedicels.

Amputated arms of the common sucker-footed star-fish act like arms isolated at both sides by severance of the nerve-ring, as just explained. Upon local irritation they draw in their pedicels, and protrude them upon being powerfully irritated; they creep forward in a definite direction, and when placed upon their backs are able even to turn themselves over like the uninjured animal. The severed arms of sand-stars are less independent. They twist about aimlessly hither and thither, but if any considerable portion of the central disc and nerve-ring adheres to them they are able to perform adaptive movements. Similarly the disc, with one or two arms attached, is not helpless; and is able to get along quite alone without any arms. We could explain all these movements by so-called reflex actions and might grant also that the mechanism that effects these results operates in this case upon a greater scale and with more independence than in other classes of animals, for the reason that here a real guiding organ is not present.

But whatever might be inferred from the experiments just described in favor of a senseless and unintelligent life of star-fishes, Professor Preyer was nevertheless able by extending his experiments to win the conviction that the old conception of star-fishes being real reflex animals was wholly untenable, since a great number of capacities and capabilities could be verified and provoked, which are intelligible only on the basis of adaptive co-operation and mutual con-

certed action in the five rays. We shall not discuss here whether this is also proved by the wonderful fact that a star-fish, which fastens its arms to everything possible, never seizes its own arm and thus, like Molière's miser, in its visits to its oyster beds never catches itself for a thief. We might say, indeed, that the arm seeking a hold does not seize its companion because it feels it and has learned by experience that it takes a Münchausen to pull one's self out of a swamp by the tops of one's boots. But we find exactly the same phenomenon among creeping plants, which clasp every kind of support in their way, but never, as Darwin observed, take hold of their own stalks; whence we might assume that there probably exists in these beings some sort of power of reflex inhibition dependent upon a property of the body and developed in consequence of the fact that clasping and grasping parts of itself would involve a useless waste of energy. We shall see, however, that under certain circumstances this instinctive "dread" of contact with self is inoperative.

But to our main task. In the simplest changes of place and position, intelligent co-operation of the arms is manifest. For if in moving from one place to another, or in turning around each arm tended to perform on its own account the necessary movements of extension or rotation, without giving any heed to the others, the animal would endure the torments of Tantalus before it could reach, if ever at all, the choice bit of food that it had scented from afar, or the ray of light towards which an obscure impulsion drove it. On the contrary, when a star-fish is spying after food, we observe it lift the ends of its pedicel-covered arms so that the downward deflected eye there situated may obtain a good view of things in the neighborhood, and if in any direction an object worth going after is discovered we see the many hundreds of sucker-feet on the five arms push out in one and the same direction,—a phenomenon that requires the presence of a very widely ramified nervous system, since every tactile pedicel needs its separate telegraph wire in order to be properly moved and not always in the same direction, as for example when the animal wishes to perform a rotation about its own axis. For these comical animals sometimes do rotate about their axis, although our simple mind wonders why a Janus-head should want to turn around,

these animals being able to look simultaneously in the four directions of the compass, and having still another eye for looking downward. Similarly in the sand-stars, to which the Medusa-heads with branched arms belong, an adaptive co-operation of the arms in creeping and swimming occurs; which can be explained only as the result of a common understanding issuing from the central ring.

It would seem to follow from Preyer's extensive observations, that as a rule no one individual arm of a star-fish enjoys to the exclusion of its fellows the prerogative of universal or even general precedence; the lead of any one arm is rather solely determined by the object sought, so that the one next to the object generally starts first and assumes the lead of the little army of arms. Of course in the case of new-growing star-fishes which have sprung from a single arm by sprouting, this is different; for in this instance the old arm will undoubtedly retain control of the others for some length of time until the young ones have reached a certain size. Preyer does not seem to have instituted observations to ascertain this, but it would be interesting to determine whether an arm of this kind always takes the lead, or in the proper cases acts as driver from behind and pushes the baby-carriage with the children before it.

Examples of surprisingly dexterous co-operation and concerted adaptive action are observed in these animals in their climbing on



Fig. 4.—RECOVERY OF NORMAL POSITION BY *ASTROPECTEN AURANTIACUS*. (After Preyer.)

* Through the end of each ray of the animal a thread is drawn and affixed to a cork; the animal lying back downwards. At first the creature swung the corks alternately inwards and outwards, taking the positions represented in the above figure. After the lapse of an hour the ray with the smallest cork attached, upon which thus the least upward pressure was exerted, was pulled downwards and sidewise and brought beneath an adjacent ray; the two opposite rays were retracted centrally, the disc lifted, the centre of gravity of the animal thus displaced, and the turning effected.

Scientists have observed members of the orders *Asteroidea* and *Ophiuroidea*, in difficult positions of this kind, display an astounding sense of equilibrium and a skilfulness in gaining firm holds, sug-

difficult surfaces, and in their attempts, also, to regain their normal position when placed on their backs or made to swim in reversed positions by discs of cork fastened to the extremities of their arms.

gestive of the athletic feats of monkeys, and that even when placed in very unusual positions such as never occur in nature. Thus many star-fishes let themselves drop from steep rocks and cliffs, if that happens to be the best way of getting down; but in such cases before they let their whole weight go hold fast to the last moment with one or two arms, as if it were previously necessary to calculate the leap into the depths below. To furnish the counter-test of this, and to prove that the central nerve-ring is, as assumed, the indispensable and necessary condition of this united co-operation, Preyer severed the ring in individual specimens of the class between every two arms, sparing the other parts as much as possible. In this way the nervous systems of the five rays were disconnected. As was expected, it was found that the more connections there were severed, the more difficult the animal found it when placed on its back to regain its normal position. For since the recovery of the normal position must be introduced by the groping about and the fastening of the pedicels of one or of several adjacent and half-turned arms, two arms or pairs of arms might for want of a mutual understanding act directly in opposition to one another and thus make the turning impossible. On the other hand, the central disc was able, though deprived of all arms, to accomplish the turning, if only the nerve-ring were preserved intact; and the more there remained of the nerve-ring on a single arm the better the single arm was able to do it.

But in circumstances which were wholly new, the adaptive co-operation of the arms demonstrated itself in so striking a manner that we may say they are not to be easily put out of countenance or confounded. When Professor Preyer, for example, slipped narrow rubber bands or cylinders over their rough spiny arms, they rid themselves as a rule of these unwonted fetters in a very short time, and in the most various but always well calculated ways. Generally the two nearest ones seized their poor imprisoned fellow "under the arms," bracing themselves with their rough spiny surface against the rubber sleeve, and thus finally stripping it off. (See Fig. 5; next page.) Sometimes, when the band was loosely adjusted, twisting movements of the arm in the water sufficed gradually to loosen it, until it could be finally cast off. Often the peeling off was effected

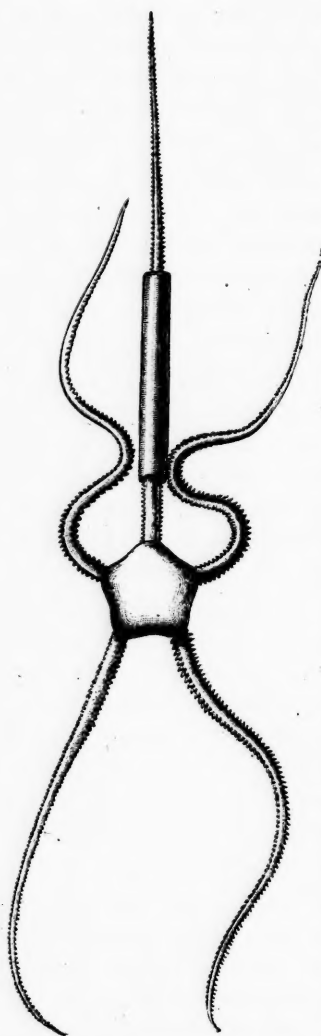


Fig. 5.—REMOVAL BY OPHIOMYXA OF A RUBBER SLEEVE. (After Preyer.)

The figure represents the moment at which the band is about to be removed. An adjacent arm is braced against the lower edge of the band, forcing it off in the direction of the extremity of the ray.

by pressing against a rough surface, whereby sometimes an adjacent arm held the sleeve fast; and when no other expedient was of avail the animal cast the arm, sleeve and all, away from itself; and the latter may possibly have not gotten rid of it at all. At times the casting off of the arm occurred subsequently, after the obstacle had been entirely removed, and often even a day later, as if the impeded arm was still sensible of some obstruction which caused it to afterwards separate from its companions.

Attempts at flight and liberation from unwonted compulsory positions or narrow confinement, also deserve special attention. Many a person who has put a star-fish into a cage and fancied that he was assured of its possession, has been disappointed on finding that the animal had effected its escape through the meshes. But star-fishes have, in consequence of their abhorrence of the air, been made to creep into the narrow necks of bottles filled with water. Professor Preyer, for example, thrust two of the arms of a common star-fish species (*Asterias glacialis*) into a tube filled with salt water leaving the three other arms exposed to the atmosphere outside; and although it would have been impossible to force the animal

into the tube without crushing it, the three arms exposed to the air were also pulled in within the space of three minutes. If the tube was placed perpendicularly in water the animal quickly crept out again. The performance seemed utterly impossible, for each single arm of the star-fish was almost as thick at its base as the greatest width of the tube, and yet three of these arms had to pass in side by side. This was made possible by the animal emptying during the passage all the numerous water-vesicles in the interior of the arms which serve to fill and to empty the distensible pedicels therein ; the star-fish, after the expulsion of the water, becomes very soft in all its parts and does not harden again until it has forced itself completely through and refilled itself with water. In order to accomplish these emptyings, bendings, turnings, and rollings, thousands of muscular fibres must work in harmony within the body of the animal. This experiment was also successfully carried out with other star-fishes, but I cannot agree with the observer when he says that in so doing he brought the animals into a completely new and hitherto unexperienced position. In their haunts on rocky coasts they must assuredly often have to force their way through narrow fissures and holes ; and they must find occasion to make use of the advantages of being able to evacuate water in the case also of single arms, as when they search with them in narrow apertures and snail-houses.

But undoubtedly new for these animals was the position in which they were fastened to a board by five long pins with broad heads, which Preyer drove in close to the central disc between the rays, so that the star-fish, as it seemed, was fastened to its resting-place in a way that admitted of no escape. Nevertheless, the star-fish found a means of freeing itself with ease and elegance from this constrained imprisonment in a great variety of ways, even when the exterior parts of their bodies were girded in by a much greater number of pins. Ordinarily they began by shoving one of their rays, accompanied by a backward bending movement of its two companions, far out between the two encompassing pins, and then drew with the greatest care first the one and then the other adjacent ray through the same narrow avenue of escape, whereupon

then the two remaining rays, the one slightly overlapping the other, were enabled to follow with perfect ease. (See Fig. 6.) A practised knot-untier who had studied the position could not have given them better advice. But if no agreement of plan and purpose existed in this case between the separate rays, if each ray sought to free itself of its own accord, a successful extrication from the difficulty could hardly have been foreseen; and we must infer from this great unanimity of action in times of danger.

Preyer thinks that at times the concurrence of all the rays in matters of concerted action might have to be effected by first obtaining the concurrence and assent of any individual ray that might be hostilely disposed; he holds it as not improbable that profound dissensions may arise between the united brothers, and refers to the fact that perhaps the voluntary section of a star-fish into a three-rayed and a two-rayed portion,—which frequently takes place,—may have to be regarded as the violent dissolution of a community of fellow animals formerly living in harmony, but now lapsed into a state of conflict. We shall pass this view by, however, to point out in a few words Preyer's general inferences with regard to the mutual relation of the five communal souls. Progression and flight in a direction once taken and unimpeded by obstacles,—an observation often made and easily verified,—the acrobatic performances, and lastly the intelligent behavior, so to say, of imprisoned and fettered star-fishes, prove that generally, and especially in moments of peril, strength-giving unanimity prevails.

But Preyer is nevertheless of opinion that it is not therefore necessary to assume the existence of a permanent central government, a central soul, holding simultaneous sway over the five radial souls, and in which is lodged, especially in times of battle, full executive power. He employs the simile of five hunting-dogs yoked together in the form of a ring, of like age, like power, and the same training, who hunt a hare in concert, or stand simultaneously and mechanically before a partridge; when thrown into the water make for the shore all in the same direction, and when equally tired fall simultaneously asleep. "Like the Siamese twins," he says, "these yoked-together dogs will have upon the whole apparently but one

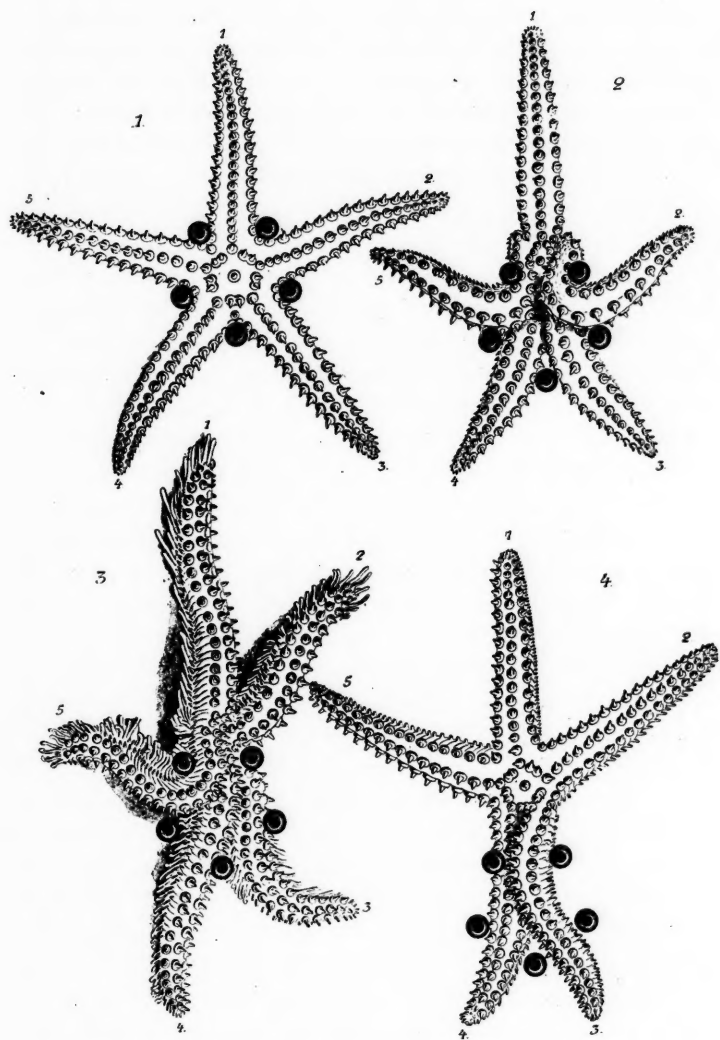


Fig. 6.—EXTRICATION OF STAR-FISH IMPRISONED INTERRADIALLY BY TACKS.
(After Preyer.)

1. Original encompassment. 2. First stage of extrication. 3. Second stage. 4. Third and last stage. The smaller figures indicate the successive positions of the same rays.

will, although they often obey only necessity in this and not their own impulses." Preyer arrives in this at the same conclusion that I pronounced in 1876 in the work I have mentioned, where I compared the concerted actions and movements of star-fishes and sea-urchins to the walking and dancing of human twin-monsters, who in spite of a difference of mental individuality, often very far reaching, nevertheless bring about perfect harmony in their external movements. In this I had especially in mind the so-called "two-headed nightingale," two girls closely united in growth, who often violently quarreled but sang and danced so harmoniously with one another that for the time being the sorrowful fate of the indissoluble union of two so different natures was completely forgotten. In the majority of their relations the five or more associates united in the star-fish are much better off than unfortunate human beings like those just described, and especially in this one particular that they do not have to die with one another, but are able to break loose with impunity from a companion whom death threatens, when they observe that he has suffered a wound or loss, simply expelling him from the community.

CARUS STERNE.

LITERARY CORRESPONDENCE.

I.

GERMAN PHILOSOPHY IN THE NINETEENTH CENTURY.

YOU have requested me to write you for your new quarterly magazine a review of the philosophy of contemporary Germany as manifested in its most important tendencies and endeavors. In setting out to comply with your wish, I feel that this is no simple task. With mere titles of books neither you nor your public will be satisfied. The readers of *The Monist* will demand a deeper insight into the workshops of German philosophy; they will want to know if the old mother soil of speculative thought has retained its pristine fertility. Fertile it has remained. But in quite another sense from formerly. In a few years a century will have elapsed since Schelling published in the *Philosophische Journal* of Niethammer and Fichte, his "General Survey of Modern Philosophical Literature," and it is well to recall to mind that treatise and that period in attempting to characterise the present state of philosophy in Germany; contrasts, we all know, are quite as important for the acquisition of knowledge as resemblances. One central problem stood at that time predominantly in the foreground; the problem, namely, of the unification of knowledge. Neither the idea nor the tendency it involves, is unknown to the philosophy of to-day, but its meaning has become a different one. At that epoch it was sought to solve the problem from within, to solve it from the centre; it was sought to find a supreme species of knowledge possessing a certainty founded unconditionally in itself, and to expand this dialectically into a system of ideas.

I do not need to set forth here the great and peculiar acquisitions that this method has won for us, nor to point out what wealth of noble power was dissipated by it in the treatment of impossible problems. These things belong to history. The speculative period of German philosophy is dead. Ludwig Feuerbach in the middle of this century sung its funeral dirge. But it took some time before people accustomed themselves to regard it as really dead,—a time in which countless attempts were made to resuscitate it; it took some time before philosophers began generally to bestow upon the corpse the kicks of abuse that Schopenhauer in its own lifetime administered to it, and for which he was rebuked by a universal silence of indignation.

Earlier history, still under the influence of the speculative masters, had characterised the progress of German philosophy from Kant to Hegel as the necessary and logical evolution of the idea of philosophy in its highest sense. But the present prevailing method of presentation is accustomed to draw a sharp, deep line at the termination of Kant's activity, and to regard the entire subsequent speculative development of the Kantian philosophy as a fallacious digression and an abandonment of the fundamental critical idea. "Back to Kant" is the watchword that has resounded since the beginning of the sixties, at first in solitary utterances, and then with greater, ever-increasing emphasis—the incipient condemnation of a period in which German philosophy had celebrated its grandest and most brilliant triumphs, and at a time when German speculative thought had just begun to grow better known and more influential abroad.

* * *

Back to Kant. Yes. But to which Kant? To the Kant of the first or the second edition of the Critique of the Pure Reason? To the Critique of the Pure or the Critique of the Practical Reason? Very perplexing questions these. The philosophy of Kant is not so easily reducible to a simple and comprehensive formula. It is a veritable Proteus, that changes at will form and appearance. Every one interprets it, in the end, as he wishes Kant should have thought. The cry "Back to Kant" has become in the ranks of

German philosophers a veritable apple of discord. An enormous Kantian literature has sprung up ; critical, exegetical, constructive. No one can dispute its acumen, learning, erudition, and profundity. But the traits of Alexandrianism unmistakably cling to it. A more pernicious waste of intellectual power, perhaps, than that of the much deplored speculative period. One has the feeling often as if one would like to cast into the tumultuous, struggling crowd of combatants a different battle cry—"Back to Nature ! Back to the examination of the true contents of things !"

I shall select on this occasion from the superabundant store of Kantian literature the works of two writers only to whom the characterisation just advanced does not apply, and to whom independent and fundamental importance belongs. They are, first, ERNST LAAS,* professor at the University of Strassburg, who died in 1885, and second, ALOIS RIEHL,† formerly of Gratz, now of Freiburg. Both began with Kantian research. Neither remained identified with it. Both sought to supply a new foundation for that branch of philosophy that deals with the theory of cognition ; both brought to the service of their task, in addition to eminent critical and analytical acumen, comprehensive historical knowledge. Widely different in method, both pursued the same end—the eradication of that transcendent bias which had so pernicious an influence with Kant himself and his immediate followers, and the replacing of all dualistic opposition of a higher and a lower, or a real and a phantom world, by a philosophy of reality based upon the rigid analysis of pure experience. Both, therefore, are, in this sense, indispensable preconditions of every monistic philosophy that is not founded on immediate intellectual perception, or mere postulates, but aims at a critical foundation.

* * *

Simultaneously with this battle for the "real" Kant and the measure of that in his philosophy which could be utilised as the

* Laas, *Idealismus und Positivismus*, 3 Vols. 1876-87.

† Riehl, *Der philosophische Kriticismus und seine Bedeutung für die positive Wissenschaft*, 3 Vols. 1876-87.

groundwork of a new structure conforming to the conditions of the times, German philosophy in the second half of this century waged another war. No fratricidal struggle this, no mere scholastic feud, but a battle for existence with a foreign foe—the physical sciences. After the speculative philosophy had retired from the throne that it had so long occupied, and the vacancy seemed yet unfilled, the attempt was made to place in the unoccupied seat another intellectual power whose credit and authority with the contemporary world had begun to keep pace with the success that attended its endeavors. We shall designate these attempts briefly as “materialism,” and understand by the term any and every endeavor that aims at constructing a conception of the world with the means and methods of the mathematical and mechanical sciences alone. That which was here sought after was the exact opposite of the state of things that obtained in the speculative period; and the treatment that the speculative philosophy had to submit to at the hands of many of the spokesmen of the new movement was not entirely undeserved. The battle that German philosophy here had to fight was no easy one. Its foe occupied every position of vantage. The real or apparent exactness of its principles, the detailed character of the structure of the world that it bade fair to offer were a power. What we want is facts, not ideas; intelligibility, not profundity—these were the demands with which philosophy was confronted. It was impossible to outflank, in this direction, the representatives of a scientific discipline that admitted of skilful popularisation. There was nothing similar to oppose to it. Philosophers were accordingly compelled to confine themselves to criticism, to show forth the unmistakable defectiveness of the pure-mechanical philosophy, the weaknesses and flaws in its demonstrations and the arbitrary character of its construction; and to point out by a display of much acute reasoning what fifty years before was self-evident, that mind and mental life are not merely an accidental phase of things, not a product incidentally resulting, but an indestructible feature of the inward nature of the world itself.

Much of this extensive antimaterialistic literature, in which may also be included by far the greater part of anti-Darwinian lit-

erature, can put forth no claim to lasting worth, and is to-day wholly antiquated. For the simple reason that people no longer understand, or at least will soon no longer be able to understand, the circumstances and conditions out of which this polemical activity sprung: namely—the transcendent metaphysical philosophy; mistaken idealism which imagined that existence and reality had to be transfigured in and by cognition instead of through will and action; the secret fear of an endangerment or indeed of a dislodgment of the religio-theological world-conception, the supernatural God-idea, the pure spiritual and immortal soul, the freedom of the will, and other phantoms whatsoever the designations they may bear.

But this warfare against materialism, which was waged by minds of widely varying rank and power, resulted at least in the substantial advantage of having brought the hostile parties closer together, of having forced them to the reciprocal study of their respective means of investigation, and of having put an end to the complete estrangement that formerly existed between them. Not only did it enrich philosophy, but it also led physical science to a correction of many of its conceptions and to a re-examination of its methodological hypotheses.

This is best to be studied, perhaps, by taking to hand the writings of a man who may be characterised pre-eminently as a spokesman of the materialistic movement in Germany,—I mean JAKOB MOLESCHOTT. His well known work *Der Kreislauf des Lebens* has become in its last, the eighth edition, something quite different from what it was in its first; and the rich collection of his lesser writings (*Kleinere Schriften*, 2 Vols., 1879–87) also offers the philosopher, especially from a methodological point of view, much that is worthy of especial attention. Moreover, this reciprocal influence of mind upon mind is manifested in the case of many of the most distinguished investigators of the last thirty years, in the most remarkable and gratifying manner. It is impossible to study the discourses and treatises of physiologists like DU BOIS-REYMOND and WILHELM PREYER, of physicists like HELMHOLTZ and ERNST MACH, and the discussions occasioned by their works, without being surprised at the extent to which the points of view of psychology and of the theory

of cognition have penetrated into the problems and inquiries of the physical sciences. And *vice versa* philosophical works, like FR. A. LANGE's History of Materialism (*Geschichte des Materialismus und Kritik seiner Bedeutung in der Gegenwart*), UEBERWEG's Collected Essays (*Gesammelte Abhandlungen*, just recently edited in a commendable manner by Moritz Brasch), the numerous works of LUDWIG NOÏRE, and, last but not least, the entire scientific activity of WILHELM WUNDT,—all show an intimate familiarity with the methods of the physical sciences and an assimilation of materials from these branches of knowledge such as the speculative period can furnish no example of.

* * *

Nevertheless, this intellectual revolution, far-reaching as it was, has led neither to solid systematic construction nor even to the successful development of positive methods of thought. Since the decline of speculative philosophy,—in which in this connection the Herbartian may also be included,—two systems only have dominantly influenced the German mind: the system of ARTHUR SCHOPENHAUER and that of HERMANN LOTZE. In both a resonance still lingers of the older time. In Schopenhauer we detect the spirit of Schelling's nature- and art-philosophy; in Lotze, traces of the finely studied subtlety of Herbartian metaphysics. But though both are indebted for a portion of their real intrinsic worth to this organic though involuntary connection with a great epoch, their influence upon the present time rests upon very different grounds; and primarily upon the symmetrical, finished, and compact totality of their intellectual creations. They arose at a time in which philosophers had begun to lay aside the older systems as useless, and in which that multitudinous dismemberment of knowledge already began to make itself felt which to-day seems to be still growing greater. Although it may be difficult in many phases of the development of science to satisfy the impulse latent in us to unify knowledge, and although this endeavor is characterised ever anew by the representatives of special research as a delusion, nay as a ruinous delusion,—yet this impulse is not to be eradicated from the human mind and in some way or other it will ever procure itself recognition. Works like *Die Welt*

als Wille und Vorstellung (World as Will and Idea), or *Der Mikrokosmos* (Microcosm) embrace in fact the entire sphere of knowledge, not in an extensive, but in an intensive sense: they furnish a definite view of the complete inter-relation and meaning of life.

It will perhaps appear strange to the reader that works are here mentioned in the same breath and their effects upon the present time discussed, which are separated in origin from each other by a space of about forty years. Yet this very anomaly is characteristic of the development of the German mind. When Schopenhauer published, in 1819, his principal work, the time for it had not yet come. The philosophy of Hegel, a rationalistic panlogism, was then in the very midst of its career of triumph. The irrationalistic and pessimistic elements of Schopenhauerian thought were repulsive. We now know that the two first editions of the *Welt als Wille und Vorstellung* mouldered in the shops of the booksellers. Not until shortly before Schopenhauer's death in 1860 did the literary public and the scholastic circles of Germany begin to occupy themselves more seriously with this philosopher. Not until then did he really enter as an active factor into our intellectual life.

This influence, in the case both of Schopenhauer and Lotze, rests, aside from the fact of the universal character of their thought-creations, already referred to, pre-eminently in the circumstance that both made thoroughly their own the scientific theory of things and recognised that conception as one whose justification was contained in itself, and which, regarded from the standpoint of its own hypotheses, was irrefutable; though they were nevertheless far removed from perceiving in it the final and irreversible verdict of human knowledge. In this endeavor to fix the limits of scientific cognition Schopenhauer and Lotze form important pillars of the antimaterialistic movement in Germany, and are just in this respect also intimately related with the task of the modern Critical Philosophy or Neo-Kantianism. But while the latter movements came to a stop with predominantly negative or preparatory criticism, Schopenhauer and Lotze owe a great portion of their wide-spread influence on German culture to the circumstance that they undertook, from the point of view of the critical theory of knowledge already ac-

quired, to sketch the plans of structures of the world which would furnish a general background and scheme of synthetic connection for the collective special results of the physical and mental sciences. That these sketches of world-construction have an individual coloring can only lessen their value in the eyes of those who believe they are privileged to apply to such a synthetic, constructive formulation of the highest ideas of all existence and thought, the standard of the exact determination of a single law. And so I shall only hastily point to the fact, that the contrariety and oppositeness that permeates the world and all our thought about the world also comes sharply to light in the case of these two philosophers, not to their mutual destruction, but to the heightenment of the effect by the contrast.

The fortunes of the two systems, which began about the same time to acquire influence, were dissimilar. The pessimistic element alone evinced itself fruitful, in the sense that it came immediately into contact with general culture through manifold forms of presentation and extensive discussion. The royal structure of the Schopenhauerian philosophy has given a host of dispensing draymen for thirty years an abundance to do. The leader of this army, EDUARD VON HARTMANN, has long since taken a place by the side of the sage of Frankfort, as independent master-builder, and presented a system planned and executed with the most diffuse architectural details. The nuclear idea of the Philosophy of the Unconscious (*Die Philosophie des Unbewussten*) has been amplified by the author himself in every direction, extended, exhibited in its historical relationships, and applied to the special departments of philosophical science. The theory of cognition, ethics, æsthetics, the philosophy of religion have all been treated of by Hartmann in the last two decades in voluminous works, and often repeatedly elaborated. In addition thereto, come several volumes of essays in which the philosopher has had something to say upon every conceivable topic, political, literary, æsthetical, pedagogical, and politico-economical. Hartmann's fecundity is only surpassed by his volubility. In him appears anew that union of philosophy and journalism that had remained disunited since the close of the period

of illumination. The utility, nay the necessity, of this combination, with which, unfortunately, the academical philosophy of the passing century would have naught to do, Hartmann knew the value of, and skilfully exhibited his appreciation; though one often wishes that its popular character had, in places, been made to do service in behalf of different ideas.

The writings of no other philosopher have obtained so wide a circulation as those of Hartmann. His chief work, "The Philosophy of the Unconscious," first published in 1870, has long since been put in stereotype form, and from time to time passes through repeated new editions. Also his numerous other writings have for the greater part been repeatedly republished. We possess a collection entitled "Select Works," and have just received a "Popular Edition." And it is moreover generally known that it has only been since the appearance of the *Philosophy of the Unconscious*, that the sale of the writings of Schopenhauer has assumed great proportions. Through the mediation of Hartmann Schopenhauer's fundamental ideas first reached the general public.

* * *

The philosophy of Lotze lacked an interpreter of like versatility and fecundity, although it had need of such a one in a much higher degree. Both thinkers were masters of the philosophical style. But Lotze's symmetrically rounded and intricate periods, with their inexhaustible influx of incident relations, makes very different demands upon the patient resignation of the reader than the lightly moving, epigrammatically pointed style of Schopenhauer. Lotze for this reason never really became popular. His influence has remained rather a scholastic and academic one. It has been fruitful in high degree in its effect on the special departments of philosophical science, particularly on psychology, whose present representatives in Germany almost without exception received from him incitation and a solid scientific view-point. Not unimportant, too, is his influence upon academic instruction in philosophy, through the "Dictations" to his lectures, published after his death, which are in every student's hands and serve in many ways as a substitute for the study of his principal work. Lotze's authority, finally, stands like a rock with

all whose great concern it is to find ways of reconciling the claims of theology and of religious belief with the present state of science.

And their number is by no means inconsiderable. Official Germany has become pious, or, at least, would like to appear so; and although this is not to be understood exactly in the sense of especial dogmatic zeal, yet people adhere nevertheless with a certain tenacity to the religious background of the prevailing world-conception. Abroad it is the custom to regard the Germans upon the whole as a nation of atheists, because they have produced several curious fellows like Strauss and Feuerbach, enjoy having a good time on Sunday, and drink plentifully. Nothing can be more erroneous than this opinion. The average German has long since learned to place implicit confidence in the declaration of his teachers, that the great critical liberal movement of the later Hegelian school is not to be seriously taken but to be looked upon merely as the outcome of a "pathologically over-excited" epoch. Nowhere in the great civilised countries has freethought practically found so little footing; nowhere is its dependence upon the central powers of government greater; nowhere is it more impossible to wrest even a tittle from the authority of the old system of education with its foundation laid in the theological world-theory.

This condition of things, the obstinacy, the timidity with which state and public opinion hold fast to religion,—and now in times of imminent social danger more so than ever,—must be borne in mind if we wish to understand the comparatively great success that the philosophy of Schopenhauer and Hartmann has had in Germany. In the support of these two systems the philosophical opposition of freethought has simply found expression—the opposition that has arisen against the official philosophy, of which it cannot exactly be said that it theologises, but which carefully avoids coming into conflict with theology, and does not, in its aristocratic academic exclusion, endeavor to influence more extended circles. The factor that made this philosophy of opposition accord with the spirit of the times—its proximity, namely, to the scientific world-theory—has already been emphasised; and the fact that its pessimistic coloring has not been changed by its connection therewith will be found intelligible

when we consider the turn that pessimism took in the hands of Hartmann. Only the quietistic Buddhism that Schopenhauer taught, could, in an age of the highest expansion and display of power both at home and abroad, appear as an incomprehensible riddle of the national mind. The evolutionistic pessimism of Hartmann, however, which demands of the individual complete and resigned submission to the struggle for existence, although it is able to offer him in the remotest background of time no better outlook than the ultimate annihilation of existence itself—is in its immediate practical commands too closely akin to an optimistic conception not to satisfy fully the needs of life, and is again too analogous to certain cosmological prophecies of natural science not to pass as the metaphysical expression of a truth otherwise accredited.

As opposed to this state of things Neo-Kantianism or the Critical Philosophy in its various forms has taken no firm position; no more than its master Kant himself did. To a great extent it makes use of the limitations of knowledge that have been critically determined, in order to leave open behind the same a realm of transcendent possibilities in which religion may lead a passably secured existence. Behind the greatest critical acumen theological prejudice is only too often concealed.

Few only of the intellectually eminent representatives of this movement like Alois Riehl and Ernst Laas exhibit in this respect perfect determination and the consciousness that the consequences of modern science unavoidably demand the laying aside of current religious conceptions and the substitution for them of more correct ones. Laas especially, in many passages of his principal work (*Idealism and Positivism*), as also in his readable little treatise *Kant's Stellung im Conflict zwischen Glauben und Wissen*,* has emphasised strongly the view that there can be ideals only for the man who acts, and that so-called ideals where mingled with the function of pure cognition only falsify reality and lead to irresolvable conflicts. And Laas likewise belongs to the few who have laid

* *Kant's Position in the Struggle between Faith and Knowledge.*

prominent stress upon the educational task of modern philosophy as a substitute for systems of religious ideas.

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From the point of view of different systematic hypotheses, but substantially with exactly the same tendencies, analogous ideas find representation in EUGEN DÜHRING, who in versatility of talent and literary activity is perhaps to be placed directly by the side of Lotze and Hartmann, though the favor in which his works stand and the circulation they have obtained fall far below the position of the latter. He presents a different form of positivistic philosophy in Germany, a philosophy not preponderantly critical but constructive, and begins with what Ludwig Feuerbach about the middle of this century in his *Principles of a Philosophy of the Future* (*Grundsätze einer Philosophie der Zukunft*) once propounded as programme. His chief work, *Cursus der Philosophie als strengwissenschaftlicher Weltanschauung und Lebensgestaltung* (Course of Philosophy as Exact-Scientific World-Conception and Conduct of Life), and the treatise against pessimism entitled *Der Werth des Lebens* (The Value of Life) sketch a world-picture that is intended theoretically to be but the simple conceptual interpretation of the present contents of experience, and therefore rejects the metaphysical constructions of Lotze, as well as the new conceptual mythology of Hartmann, and criticistic doubts concerning the objective reality of the world given in consciousness. In the practical direction, as an offset to the world-throe of humanity, the gladdening power of a life and action based on universal sympathy is emphasised. Dühring is a unique, but isolated phenomenon; standing, like Schopenhauer once did, in sullen antagonism towards the official academic philosophy, and totally ignored by it; unable by virtue of the conditions already delineated to influence wider circles, which the unanimated rigidity of his manner of presentation does not contribute to make easy. Eminent mental endowment and extensive knowledge are perhaps displayed in a higher degree in his historical works (*Kritische Geschichte der Allgemeinen Principien der Mechanik* *;

* *Critical History of the General Principles of Mechanics.*

*Kritische Geschichte der Philosophie**; *Kritische Geschichte der Nationalökonomie und des Socialismus*†) than in his systematic treatises.

Nevertheless, Dühring can at the farthest be regarded only as one of the forerunners of that Messiah that is destined for German philosophy and German intellectual culture perhaps in the coming century; of that man who shall be able to cast up the accounts of the work of the present period, with its infinite analyses, its historical comparative character, and its pyramidal yield of material, and to condense that which now everywhere surges about us like a spiritual ether, but nowhere palpable or tangible, into the unity of a system that shall point out the paths to be followed and shall dominate all minds.

* * *

There are many,—and among them eminent investigators and estimable scholars,—who smile at this prophecy as an Utopian dream; nay, almost stand in dread of such hopes, as perilous to science. The day of systems, say they, is past. Philosophy, too,—perhaps it were more proper to say “mental science,”—is breaking up into a number of special sciences, over which it is sought to place a general science of knowledge or theory of science, as the last representative of that which was once called philosophy and was recognised as the queen of the sciences.

As intimated, I do not know whether the impulse toward unity that inheres in the human mind is to be so easily driven from the field; whether we shall be satisfied in the long run to behold that light that irradiates the universe, broken a hundred-fold by the prisms of the single sciences. But one thing is certain. The more irresolute they are in whom the science of the future places its confidence, the more actively will they press forward who hold that the precious treasure of truth has long since been granted unto man, and who would fain forge with this heritage of the past the fetters of the future. After the Catholic church under Pius IX. had hurled in the face of modern culture and science its frantic *Anathema sit*, it began

* *Critical History of Philosophy.*

† *Critical History of Political Economy and Socialism.*

under his successor a much quieter, yet far more determined warfare. Like one of the famed lianas of the primeval tropical forests, it entwines the giant Science, to sap his best powers and slowly but surely to stifle his life. Whatever the modern mind with the help of freedom won by bitter struggles has gained in the knowledge of nature and of history, is twisted and turned, falsified and misinterpreted by hundreds and hundreds of busy hands until it has been fashioned to fit that ready-made scheme of things composed on the one hand of Catholic dogmatical teachings, and on the other of the Aristotelian-Thomistic philosophy. As many representatives as secular freethought can show, there will be found beside them to-day an ecclesiastical *advocatus diaboli* who will neither rest nor cease until of the hero has been made a wretch and mangy heresiarch.

Under protection of the principle of free inquiry, and with all the helps of science, a warfare of extermination is here carried on against all freedom of mind and all science, which is the more dangerous in proportion as the opponent loves to decorate himself with the borrowed plumes of science, and as he is able skilfully to mask his real designs. Catholicism is striving with untiring efforts to gain by the help of this reformed and modernised scholasticism, the mastery of the schools, of education, of the universities, and of the entire activity of science. And compared with the position of the representatives of modern thought it has decidedly the advantage. Not only is it in the possession of a unitary world-theory, but it defends that theory with most determined vigor and heedlessness against all differing views. The representatives of modern science, on the contrary, are not so fortunate as to possess inherited truth and infallible authority, and they not only have to contend with the formidable internal difficulties that stand in the way of a unitary formulation of their conception of the world, but frequently even avoid entering on this task with determination in order to make less prominent the contrast with the religio-theological system to which every exact scientific conception of the world must of necessity lead.

Against these aggressive endeavors of the theological mind, neither lofty indifference, nor calm historical contemplation, nor

mere literary warring will avail. The power of freethought must be displayed, and the positive work that it can do must be shown. Otherwise the time may come when the fame of rigid scientific thought and successful research in special fields will not exonerate German philosophy from the reproach of having left the nation in the lurch at a period of momentous spiritual crisis. To make useful the rich acquisitions of these labors toward the construction of a general theory of the world, remains, therefore, the serious task of the German philosophy of the future.

I shall be permitted, perhaps, in a future article to present an account of the literature of these special departments.

FRIEDRICH JODL.

RECENT FRENCH PUBLICATIONS.

THE works that have appeared during the last three months belong to authors of different nationalities—Italian, Roumanian, Belgian, and I ought to add Russian ; but I shall not speak on this occasion of the important work of Sergneyeff, *Physiologie de la Veille et du Sommeil*.

It is, as you see, a gathering of good company, on French soil.*

* * *

The only French work to be mentioned is that of M. CH. ADAM, *Philosophie de François Bacon*, a memoir presented in the prize competition of which M. Barthélemy Saint-Hilaire was the reporter and preferred by the Academy of Moral and Political sciences.

M. Ch. Adam is already known by several works relating to the history of philosophy. The study which he now gives to the public is conscientious ; we must commend his erudition and the moderation he has displayed both in his praise and in his criticism. I am not sure, however, if he is right in asserting that the fame of Bacon will increase and diminish alternately, according to whether patient analyses or daring hypotheses find the more favor in the scientific world. I have known many a savant, profoundly metaphysical and imaginative, who, in admiring Bacon, delusively believed himself in the possession of a solid safeguard against metaphysics. There is more chance, to my mind, of finding the admirers of the Chancellor among pure philosophers than among men of science. This is why I subscribe completely to the judgment of M. Ch. Adam, when he subordinates Bacon to Descartes and to Galileo. Especially should he be put below Galileo, who was the great initiator of modern science, at least the first to add a link to the chain of human science then being forged ; one, I might say,

* All these works are published by Alcan.

who by his solid contributions really founded physical science, as chemistry was founded by Lavoisier and his contemporaries a century and a half later.

* * *

The Roumanian writer is M. BASILE CONTA, whose unfinished work, *Les Fondements de la Métaphysique*, has been translated by M. Tescanu. M. Conta died in the heyday of his powers. Born in 1845, he was successively, from 1875 to 1881, professor of jurisprudence at the University of Jassy, deputy, and minister of public instruction. The author and his works have, therefore, serious claims to our attention. Nevertheless, I can hardly believe that M. Conta always kept in the path in which he started, for if he had, it would have led him to considerable results.

M. Conta held that every combination of ideas, that is to say every ultimate generalisation, is essentially mobile, alterable in character, and that there will never be any final, definitive philosophical system. Subject to the benefit of this wise reserve, he undertook, nevertheless, to frame a "materialist" metaphysic, founded like the positive sciences on induction, and he attempted to rise to a general system, from which it appeared to him that the ancient notions of the soul, of freedom, and of God could not be legitimately excluded.

According to my mind, the defect of his method was the allowing too much to reasoning, the too great desire to create reality by simple logic. Unfortunately, the intellectual necessity that he proclaimed, of reducing all to unity, does not carry with it the means of properly making this reduction by a subtle operation of the mind. In order to advance towards his end, M. Conta found himself led to formulate a compendious sketch of a theory of cognition, a psychology, and a logic, at the risk of sinking at times in the quicksands of a treacherous discussion. As a matter of fact, metaphysics, spiritualism, and materialism, are conceptions of great vagueness, and the problem to reconcile them by any fashion of union, is rather like inquiring how many ways there are of placing three persons at table, or even a greater number.

This is not said by way of disputing the merits of a writer

whose loss is justly regretted, or to discourage the reading of a book in which many will find much to accept.

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The Belgian author is M. ALBERT BONJEAN, a barrister of Verviers. His book, *L'Hypnotisme, ses Rapports avec le Droit et la Thérapeutique, la Suggestion Mentale*, affects too much the style of an address before a court in which the orator wishes to exhibit wit and acumen. Nevertheless, it is written with clearness, is agreeable to read, and the verbal nicety sought does not impair its good sense.

M. Bonjean has developed the three following theses: First, that the action of magnetism is not explained by the hypothesis of a fluid, that we cannot speak with M. Ochorowicz, of "a certain tonic vibratory movement which propagates itself outward from the periphery of the body," but that it is explainable by simple suggestion; second, that the power of suggestion is almost unlimited; and third, that though verbal suggestion is incontestable, mental suggestion remains doubtful until proof to the contrary.

M. Bonjean thus sides with MM. Ochorowicz and Delbœuf, and the whole school of Nancy, against that of the Salpêtrière. He endeavors especially to show the serious consequences, in criminal and civil affairs, of immoral suggestions, the dangers of which he reproaches M. Gilles de la Tourette with having concealed far too much. His personal conviction does not rest itself solely on the expositions of others, but on experiments which seem to have been conducted with prudence.

Extraordinary as this almost passive obedience of a subject to the suggestion of an act which is repugnant to his moral tendencies appears, we come in a position, it seems to me, to comprehend it by the observation of the degenerate patients of our asylums in their various manias. The dipsomaniac resists with all his power the impulse to drink, and the kleptomaniac the impulse to steal; they fight against it even to agony, but they end always by yielding to it. "It was stronger than I"; such is the formula that we have noted most often in the answers of these unfortunates. And remark, that the dipsomaniac does not drink for pleasure, but by compulsion, be the beverage what it may, water, urine, or petroleum; just as the

kleptomaniac does not steal with a view to enjoying the product of his theft, which he ordinarily abandons or restores, but steals to deliver himself from agonising torture. In this manner also the onomatomaniac acts, who is seeking a word, and who rises at night to consult the dictionary, etc. The hypnotised subject is in the same predicament, whatever pathological difference there may be between the two; his personality has momentarily sunk in hypnosis, as does that of an insane person during the attack of insanity; his moral resistance must finally yield, and it is not at all remarkable that it does.

The volume of M. Bonjean ends with an interesting discussion of the celebrated case of Lully. The deceit that gave rise to belief in suggestion without words or gestures appears to be established; the subject reads from the lips of his magnetiser.

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Let us turn to the fine work of M. R. GAROFALO, *La Criminologie, Etude sur la Nature du Crime et la Théorie de la Pénalité*. M. Garofalo has himself translated his work from the Italian; this second edition is entirely recast.

The Italians have always had a taste for juridical studies. Their school of criminologists has placed itself at the head of the movement which ought to result in the reform of all criminal codes. Two principal tendencies are predominant in the works of this school: the physicians and anthropologists, for example M. Lombroso, have conformably to their mental tendencies, particularly studied the *criminal*, of whom they have endeavored to fix the type; the jurists, like M. Garofalo, vice-president of the civil tribunal of Naples, consider by preference the *crime*, which they determine by reference to our social organisation. M. Garofalo shows himself at once an innovator, in that he endeavors to give a positive definition of crime, to take the place of the vague and incomplete definition which was accepted by the old jurists, and conforming to which anthropologists have thought themselves able to mark the characteristics of the criminal man. That definition has relation to the average morality of the societies of to-day; crime or criminal offence is to be sought, according to him, only in the violation of altruistic sentiments ac-

quired and consolidated in the average social individual—compassion and probity. New categories ought then to be established ; that of “revolutionists,” for example, with whom the offence does not proclaim moral monstrosity.

The violation of altruistic sentiments certainly reveals in the offender a grave anomaly ; it marks him as not adapted to the conditions of society, and even incapable of adapting himself to them, in consequence of psychical and physiological irregularities. The principle, then, is correct, although M. Garofalo has based it on an analysis of sentiments which appears to me insufficient. The sympathetic emotions which compassion embraces, are not the only source of our moral activity ; probity arises in part from intelligence, and the logical sense intervenes to give the form of justice or injustice to an act of passion. Now, feebleness of judgment becomes, incidentally, an important element of the diagnosis of the criminal. Let us agree, nevertheless, that the absence of compassion and of probity upon the whole makes up the “natural crime.” This suffices surely in practice.

On the other hand, it is not convenient, and it is unquestionably not indispensable, to make a difference between an anomaly “in relation to a superior civilised type,” and an anomaly “in relation to the human type itself.” Here is the criterion that M. Garofalo—prepossessed as he is to take away from born criminals the benefit, too easily obtained, of disease—proposes to us, in order to distinguish from the anomaly truly morbid, an anomaly not pathological, but which depends in some way on the cerebral organisation. Subtle is this distinction which he opposes to the opinion of French alienists, according to whom the immoral are always more or less physically degenerated. I will confine myself to recalling on this point a remark of Dr. Magnan. Very often, said this eminent clinician one day to me, a father of poor moral stability but otherwise healthy of body, has a son well balanced in his moral and intellectual tendencies but already on the way to degeneracy. The anatomical anomaly invoked by M. Garofalo would be then not far from the physiological anomaly ; functional disturbance of the higher faculties is not alone concerned. Fundamentally, this

is of little moment to the practical conclusions of his system, which we must rapidly indicate. With regard to the repression of crime, and as to a large category of criminals, the social point of view necessarily dominates the medical point of view.

M. Garofalo inquires what the power of education and of the increase of well-being is in diminishing crime. He has found them extremely weak. Severity of repression alone appears of some efficacy; indulgence augments crime. For the sake of social selection, the criminal ought to be eliminated, by capital punishment, perpetual banishment, etc., according as the case demands. Temporary imprisonment has no place in this system. Finally, the only criterion of penalty is lack of adaptability to social life; this criterion will replace the false principles of "moral responsibility" and "proportionment of the punishment to the crime." It is too apparent that the prevailing penal theory and the jurisprudence in agreement with it, seem to tend to protect the criminal against society, rather than society against the criminal. And what absurdities besides! The attempt is less severely treated than the consummated offence; preparatory acts are *never* punished, the attempt at a crime is *always* punished.

The criterion of penalty once accepted, it is necessary to find the indices of this lack of fitness, of the impossibility of adaptation to social life, which justifies repression. M. Garofalo seeks them no longer in "premeditation," but he finds them in the motive of the crime and in the way in which it has been prepared or perpetrated. We cannot follow him into the details of this discussion, which presents the highest interest. Our exceptions would turn on the interpretation of certain features; they do not bear on the general principles of this great and solid work.

LUCIEN ARRÉAT.

BOOK REVIEWS.

THE PRINCIPLES OF PSYCHOLOGY. By *William James*, Professor of Psychology in Harvard University. In two volumes. New York: Henry Holt & Co., American Science Series. Advanced Course.

In the present status of psychological science every attempt to gather the diversified facts and views and present them in a single, though extensive work, cannot but be scrutinised with great care and interest; and when this work comes from the pen of one who has gained so wide and appreciative a circle of readers, the interest becomes deeper and more personal.

It was, perhaps, the professor of mental science, struggling for years with text-books, inadequate, or antiquated, or narrow, or unscientific, or dry, or unpedagogic, who most anxiously awaited the appearance of Professor James's volumes; and his expectation was the more warranted, as the work was announced in a series of text-books deservedly successful and popular. To such a one, the work itself does not come to fill the place of a text-book; not alone the great length (1,400 pages), but the general supposition of knowledge on the part of the reader which it is the object of college courses to supply, together with the selection of topics and the peculiar division of space amongst them, limit the work to students of a much more advanced type than (unfortunately, perhaps) American education as yet supplies. But while our professor must still patiently hope for some work that will present in brief and convenient form the main facts of Psychology, he will find his task made easier and more interesting by these welcome volumes. He will find in them an original and frequently brilliant treatment of many of the deepest problems of modern Psychology: and it is as a contribution to science and as an aid to the professional student that a discussion of their contents and tenets will be pertinent in these pages.

To begin with, the attitude of the author to his subject is that of a professional scientist to his specialty. "I have kept close," he says, "to the point of view of 'natural science throughout the book. Every natural science assumes certain 'data uncritically, and declines to challenge the elements between which its own 'laws' obtain, and from which its own deductions are carried on. . . . This 'book, assuming that thoughts and feelings exist, and are vehicles of knowledge, 'thereupon contends that Psychology, when she has ascertained the empirical

"correlation of the various sorts of thought or feeling with definite conditions of the brain, can go no farther—can go no farther than is as a natural science. If she goes farther she becomes metaphysical."

This position does not carry with it the condemnation of all matters metaphysical, but simply excludes them from Psychology; nor does this independence place Psychology in a position unrelated to other sciences. Such relation is a cardinal fact in the mental world, and nowhere is it more necessary to bear in mind that the division of the sciences is largely an expression of the lines of men's interests and the inevitable specialisation of knowledge. Those forms of adaptations of means to ends which we study as forms of psychic action, while theoretically distinguishable from other modes of action, in fact, often resemble them; in other words, "the boundary line of the mental faculty is certainly vague. It is better not to be pedantic, but to let the science be as vague as the subject," and include all facts, whether they are usually called physiological, or biological, or not, that shed light on the main problems dealt with.

This conception accordingly views mind as distinctly related to and an essential part of its environment; it views mental phenomena as infinitely varied, as most intricately conditioned by and in turn conditioning other natural phenomena. For the complete survey of its domain, it calls upon experiment, observation, introspection, comparison, analysis, hypothesis, deduction, each properly controlled by the others, and limited by community of purpose to a firm foundation of fact.

It is true that in the more intricate problems, those with the smallest connection with sensation and the largest with inference and analysis, the author will be regarded as more metaphysical than psychological and plainly admits his fault; it is true that the personal leanings of the author lead him to lengthy discussions of these more intricate points, but none the less the positive, broad, and evolutionary spirit that dominates the general view of the subject leaves a clear impress of vitality, progress, and interest on every page.

Passing from point of view and purpose to content we do not look for and do not find any 'closed system,' but "a mass of descriptive details" in the selection of which personal interest has been the controlling factor. The articles which Professor James has written from time to time in the periodicals appear, sometimes a little remodelled, in the larger work; each chapter is thus largely an independent essay upon the topic printed at the head of it. On the physiological side we have an admirable chapter on the functions of the brain, but elsewhere the student is referred to other works for the physiological points involved.

Following this is an excellent essay on Habit and Automatism, whereupon without further ceremony the reader is invited to a somewhat speculative series of chapters upon 'Mind Stuff,' 'Knowledge and Reality,' and the like, and may resume the more concrete chapters on Attention, Conception, Discrimination and Comparison, Association, only after struggling with the complex picture of 'the

Stream of Thought,' 'the Consciousness of Self,' and 'the Snares of Psychology.' Each of these chapters presents a distinct problem, presents it well and positively, and contributes much that is original to the discussion.

In all this there is strongly emphasised the subjective contribution to Psychology,—the value of a discerning and critical introspection and the importance of the subject in all processes of sense, judgment, attention, association, and the like. The mind is not a passive receptacle of experiences, but is continually active, making and shaping, seizing and transforming, absorbing and assimilating the stimuli of its environment.

A second series of topics take up the perception of those general concepts, Time, 'Things,' Space, Reality, and Form, the largest and heaviest chapters in the work, amongst which, as if to whet the appetite, are distributed more concrete pages dealing with Memory, Sensation, and Imagination. The former devote much space to criticism, and would, perhaps, border upon the metaphysics that was to have been avoided, were it not that they spring from considerations much more concrete and provable; the latter group of chapters are amongst the most interesting of the volume, and though treating but a small and somewhat arbitrarily selected portion of each of the topics, treat them in a suggestive and inspiring way. Discerning and ingenious sketches of single mental traits and processes, happy illustrations, suggestive side issues make these pages a striking contrast to the usual text-book tone, and will attract students of all shades and grades of agreement or disagreement with the author's views.

The remaining chapters deal with Reasoning, Movement, Instinct, Emotions, Will, Hypnotism, Necessary Truths; in addition to the characteristics already indicated, we find here a wise use of the facts of Morbid Psychology, of the inferences from the abnormal to the normal. This naturally stands out prominently in the discussion of Hypnotism—so recent and yet so essential a department of mental science.

When we close the cover of the second volume we do so with the feeling that our mental horizon has been enlarged, our interests have been quickened, our attention has been held, our time agreeably spent,—and yet the result of all this reading seems intangible, diffuse, scattered, unsatisfactory. The scholar and the professor always retain the student feeling and the student habit of thought; and what is unpedagogic for the one is uneconomical for the other. A logical order of exposition, a unifying grouping of topics, a just perspective of details, a painstaking selection of facts, constitute much to convert useless knowledge into useful science; such works contain a large element of drudgery, must be impersonal in one sense of the term, and yet are not inconsistent with a high degree of originality, but it is such works that are enormously helpful, that form landmarks by which progress is measured and retained. These useful qualities we miss in Professor James's work. True, it does not pretend to possess them, but psychological text-books are not written every day, and when so influential a one appears, the wish that its

utility shall reach a maximum demands expression. Finally, it is a work destined to be much quoted, to arouse considerable discussion, to excite quite different opinions from different critics, and so, every one interested in modern Psychology will find it necessary and profitable to learn at first hand this important American contribution to the science of Psychology.

J. J.

THE SCIENCE OF THOUGHT. By *Charles Carroll Everett, D. D.* Boston: De Wolfe Fiske & Co. Revised edition.

An excellent manual of that which is accepted as logic. The author is a disciple of Hegel, and throughout conforms his treatment of the topic to the lines laid down by his master, although in various connections where these lines permit, the author contributes from his own resources, and from other masters, much needed supplementary matter.

The appearance of late of so many essays, manuals, and treatises professing to deal with logic and its affiliated topics is quite noteworthy, and is the manifestation of a need that has become, not merely a crying, but an absolutely groaning one. It is scarcely a metaphor to say that to-day the intellectual world is in great travail over its need of an organon. We are crying unto our logical desire from the depths of our souls and waiting for it as they that wait for the morning. This intensity of our want makes us intolerant of the old incompetences and sets us to fault-finding in the hope of better insight when the current obscurities shall have been dissipated. We scan each effort as it appears, and as it discovers no even single clear organic general principle around which the wealth of knowledge now ascertained can set in order we lay it aside with a feeling of being merely tantalised. We cannot but assimilate our condition to that of the Haunted Man in Bret Harte's clever travesty of Dickens: "'Here again?' said the Haunted Man. "'Here again,' assented the phantom, in a low tone. 'Another novel?' 'Another novel.' 'The old story?' 'The old story.' 'It won't do, Charles! It won't do!' and the Haunted Man buried his head in his hands and groaned."

When the singular difficulties of the search are considered, all this is, no doubt, void of that sweet reasonableness that should obtain. Still the interests of progress are too supreme to permit any compromise with error or incompetence.

So, although the excellent manual under notice makes no pretensions that are unwarrantable, according to the customs usually observed in such cases, it yet affords salient features, apt as texts for a course of comment that applies, not merely to the doctrine and treatment adopted in it but to the doctrine and methods of the accepted logic-books in general.

The book is entitled, "The Science of Thought." This exposes an incompetent comprehension of the topic. The Science of Thought should be a mere branch of psychology. In logic, we of course, have an almost prime need of information concerning the anatomy and physiology of thought. But this is not the peculiar motive of logic. The *raison d'être* of logic is not the *general* economy of thought,

but the phenomena of *untrue, incompetent, or fallacious* thought, or, in other words, *erroneous thought*. Did but the mind of man always supply him with true and competent thoughts he would find no need of seeking logical criteria, however much he might be interested in the phenomenology of thought in general.

Man being, however, what he is, informed by a mind, prone to error, and he, in consequence, frequently subjected to evils and misses that better information would have enabled him to avoid or mitigate, he naturally seeks to solve the causes of his errors, and to discover means of testing the worth of his thoughts and of deriving thoughts that are true and competent. This search is the study of logic; the true information relevant thereto is logic, and no other device of man ought to trespass upon the name. Using for this turn the word truth in a broader sense than usual, so as to include the sense of competence, we may say that Logic is the Science of Truth and Untruth in Thought,—take notice, *in thought*—for we are supposing that there neither is, nor can be, any other or further *means* of becoming aware of aught of the nature or features, of aught that is pure alternate to mind, than thought merely, and that, therefore, truth and untruth in thought exhausts all the proper possibilities of truth and untruth.

Following Hegel, and concurring with so many others, our author starts with Being as the proper primordial universal notion. Is this not taking note merely of the comprehensive meaning of thought, in ignorance of its denominate meaning? Prior, at least logically, to Being, Form, Mode, Limit, Relation, and the like, must there not be posited or supposed somewhat *to be, to be formed, to be modulated, to be limited, to be related, etc?* Must not Quality be quality of somewhat, and Quantity, quantity of somewhat? So it seems to us and we therefore posit Ground as primordial in thought. Ground as intended here is not the same as the Absolute Being of Hegel. It is in general independent of the notions either of existence or reality, being in general that of which aught is predicative either in discourse or thought. It is pure logical denomination free of all logical comprehension. The imaginary number and the ideal number of mathematics are each just as truly grounds according to this intent as is a house or a tree.

Ground is the seat or basis of Being, Mind, Form, Mode, Limitation, Relation, etc. Behind any momented thought, say Sun shines, Mind thinks, or It is, lies, it may be latent, but all potential, the mere thought stripped of all comprehension: Sun, Mind, or It. It is wholly irrelevant that a ground is manifest only by means of its comprehension if it be true that it *must* be supposed as the seat of that comprehension. Undistributed and therefore unrelated or absolute ground from its very nature admits of no other predicate than mere being. It is in general at once the All and Existence. Its negative or Naught has no ground, being, or comprehension whatever, and no proper denomination, its name being only quasi-denominative and for convenience of notation merely. Form or Thought breaks this barren universe of mere Ground and Being by the formation of modes of Ground and by the more or less arbitrary fiat and finds of Limitation.

By the formation of Mode emerge Form, Time, and Extent, and perhaps Cause and Aim. By Limitation emerge Part and Whole, Number, and Relation in all their manifold involutions. Attribute being only *degraded* Relation, and Quantity being only one *power* of Relation.

It is a most notable peculiarity of thought that it has the ability and that it is its custom to take any form or phase of Being, and regard and deal with it as a ground.

Hence every momented thought (which in effect embraces every thought properly speaking) makes two distinct references, its ground reference and its being or predicate reference. This seems to be the bottom truth in respect to the much vexed topic of extension and comprehension. There would seem to be, therefore, in reality only two ultimate categories, Ground and Being.

As to how the categories, usually taken as such, and their complements, should be distributed between Ground and Being, would seem to be a matter requiring much pondering to arrange. Owing to the double quality of so many of the mental alternates, as in one regard Being and in another regard Ground, much difficulty might well be anticipated.

Neglecting this distribution we may say that very universal terms of thought are Ground, Being, Form, Mode, Limit, Number, Part, Relation, Epoch, Place, Alteration, Event, Cause, Effect, Aim, and the like.

The cardinal mental activities which *produce* thought seem to be, in order, Attention, Conception, Recognition, Induction, and Deduction. In all these operations there is opportunity for not only true, but erroneous thought, and logic in its office as the inspector and judge of thought in respect of its truth or error, should study all these operations and those which are subsidiary to them, and ascertain the causes of error and the means of truth, and perfect methods of deriving truth with certainty and ease.

It is very presumptuous and hazardous to essay a definition of truth, yet since such a definition is a great desideratum, and since it will not be effected except by earnest trial, and since also, in such a matter, even failures that are consequent on devoted attempts are instructive to subsequent attempts, we venture our submission :

A thought is true which while representing, its applicate (that is whatever to which it is directly applied) also, in so far as its purport implies, represents in mind a thorough and respective parity and ratio, through which each thought-analyton and thought-syntheton (whether ground, mode, limit, number, part, relation, etc.) corresponds to its proper applicate-analyton or applicate-syntheton. Truth is this representative and correspondent parity and ratio in general. A thought may be true and yet incompetent, that is unfit to serve some assigned purpose or turn in view, by reason, it may be, of its irrelevancy, or it may be of its restricted application or purport. It is a question that has been much mooted whether or not our sensations are true to their mind-alternate excitants. The ar-

gument towards showing that they are would be prolix and must be passed. If however they are not true it would be interesting to hear by what quality or nature they are to be characterised in respect to their verity.

Attention is a mental activity of considerable importance in logic in connection with that very fruitful source of error, mal-observation. But by far the most important mental activity to be studied and thoroughly known for the behests of logic is Conception, with its all important adjunct of denomination. The verity or error of all other mental operations that generate thought depends largely on the truth or untruth, the competence or incompetence of Conception. On our conceptions as a basis is erected and must ever be erected every scheme of our notation, and in so far as our conceptions are untrue or incompetent, so probably is, and so will be, in perhaps a multiple measure, all our knowledge. Very much more ought to be said in this connection, but space will not permit.

The mental operation which is here called Recognition, but which has been called hypothesis and otherwise, and which the author reviewed calls Identification, has not received the attention from logicians in general which its importance requires. It is a true variety of inference, as Mr. C. S. Peirce has fully shown. Our conceptions which are the central facts of logic would be of little value to us were we not able truly to subsume our perceptions under them. A variety of facts are available to show how very often we do this wrongly, imperfectly, or not at all.

Induction, and its rationale, depends also very largely upon conception and its intimate consequences, denomination, attribution, and relationising. Deduction and the Syllogism are trite themes, although the part that attribution plays in the process has been insufficiently noticed, and although the rules of deduction from relation-terms, the most important and fruitful of all, are as yet very partially ascertained. What is needed as an indispensable prerequisite to this last, seems to be a census and classification of the manifold relations that are known, after the model of say Roget's Thesaurus, and then a determination of the consequences of such combinations and constructions as are admissible and fruitful, and a tabulation of the same as our multiplication table is a tabulation of the consequences of the multiplication of numbers. The Logic of Relatives as it is called suffers from its having been formed thus far on so very abstract and formal a plan that its formation lacks the check and correction of frequent comparison with concrete knowledge, while its results are almost if not quite useless owing to their extreme generality, which in defect of the mediate formula leaves them inapplicable to aught that can manifest their utility or power.

F. C. R.

THE TIME-RELATIONS OF MENTAL PHENOMENA. By *Joseph Jastrow*. New York: N. D. C. Hodges.

The accomplished Professor of Psychology at the University of Wisconsin gives in this publication, which forms one of the series of "Facts and Theory Papers" issued by Mr. Hodges, the results of numerous observations by Cattell,

Münsterberg and other observers. His object is to present a general view of what has been done already in this department of research. The study of the time-relations of mental phenomena is of importance in various connections. As Professor Jastrow remarks:

"It serves as an index of mental complexity, giving the sanction of objective demonstration to the results of subjective observation; it indicates a mode of analysis of the simpler mental acts, as well as the relation of these laboratory products to the processes of daily life; it demonstrates the close interrelation of psychological with physiological facts, an analysis of the former being indispensable to the right comprehension of the latter; it suggests means of lightening and shortening mental operations, and thus offers a mode of improving educational methods; and it promises in various directions to deepen and widen our knowledge of those processes by the complication and elaboration of which our mental life is so wonderfully built up."

The results of the observations referred to by Professor Jastrow are given in Tables of Simple Reaction Times and of Complex Reaction Times. One of the most important points considered is "the overlapping of mental processes," as to which Cattell made a special study. From the fact that the time needed for the performance of complete operations, as multiplying numbers and reciting a verse or two at the same time, is shorter than the sum of the times required to do each separately, it is inferred that the mind should be likened not "to a point at which but a single object can impinge at one time, but rather to a surface of variable extension." Moreover, "the performance of a complex and extended mental task is not the same thing as the separate performance of the several elements into which that task may be analysed." The addition of a classified Bibliography adds much to the value of Professor Jastrow's interesting little work. Ω.

ON SAMENESS AND IDENTITY. By *George Stuart Fullerton*. Philadelphia: University of Pennsylvania Press.

Mr. Fullerton's psychological study is the first of a series of contributions to Philosophy to be issued by the University of Pennsylvania. It is truly entitled a "contribution to the foundations of a Theory of Knowledge," and is an attempt to arrive at an accurate conclusion as to the several senses in which the word *same* is used; with an historical and critical statement of the use of the word in a wrong sense. Mr. Fullerton finds that *same* has seven different meanings according to the mode in which it is applied. In the first case it has the sense of *identity*, and in the second that of *similarity*. Thirdly, the "external" bundle of qualities may be regarded as being the same at two different times, while in a fourth sense, two "external" things, or "external" qualities, existing at one time, may be called the same to mark similarity. Again, an "external" thing or an "external" quality may be called the *same* with its external representative, as the identification of a thing with its reflection in a mirror. This is the fifth sense; the sixth is where the

same "external" object is said to be perceived by different persons. Finally, an "external" thing may be said to be the same "with its representative in consciousness or with the substance or noumenon assumed to underlie it."

On searching for the reason why such various experiences are expressed by the use of one word, Mr. Fullerton discovers that the common notion which unites them is the idea of similarity. But how can we speak of similarity when strictly only one thing is in question? The answer given is that we have "a series of experiences, beginning with one in which two objects are recognised as similar and yet are very clearly distinguished as two objects, continued in others in which the sense of duality falls more and more into the background, and ending in one in which there is no consciousness of duality at all." The last of these experiences is not wholly different from the others. It differs from them "not in the element which has led us to declare two objects similar—the element which they have in common—but in that which has led us to declare them two and different. It is by adding to this last experience, so to speak, that we get the others. They contain it and more." The experience in which two things are not distinguished, is at the bottom of all our experiences of similarity. The use of the expression "X is X," then, emphasises the fact that one is not to pass from X to any Y or Z, and it, moreover, puts a period to one's thinking, and fixes the thought upon X alone. When the words "identity" and "sameness" are intended to be used with some degree of precision, the former word indicates "sameness in which there is no consciousness of duality, or in which the consciousness of duality has fallen into the background and may easily be overlooked."

More than half of Mr. Fullerton's work is occupied by an historical and critical consideration of the use of the word *same* in a wrong sense, beginning with Heraclitus and coming down to Prof. W. K. Clifford. The examples he has given of that confusion of thought justifies the assertion of "the need of much greater care and exactitude than one commonly finds in metaphysical reasonings," and at the same time the hair-splitting for which Mr. Fullerton needlessly considers himself called on to plead guilty.

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INDUCTION AND DEDUCTION. WITH OTHER ESSAYS. By *Constance C. W. Naden*. Edited by R. Lewins, M. D. London: Bickers & Son.

The chief of the essays comprised in this volume is an "historical and critical sketch of successive philosophical conceptions respecting the relations between inductive and deductive thought." It was awarded the Heslop Gold Medal as the best dissertation by a student of Mason College, Birmingham (England), in 1887, and Miss Naden was also rewarded for it by being made an Associate of the College, an honor she well deserved. The dissertation displays a wide knowledge of scientific facts with a rare capacity for dealing with them in a philosophical spirit, and a power of acute reasoning such as few other women have ever possessed. Whether her opinions are always correct is another question. It is a profound remark that

we are obliged to regard nature as a system, "because we can consider its multiplicity only in relation to one thinking subject." But we must challenge her statement that we have no certainty for assuming that the laws of nature will always remain unchanged. A change in the laws of nature would be the replacing of it by a different nature of which man could not take cognisance, and which therefore we cannot reasonably conceive to be possible. There might be a change of conditions which would introduce other laws, but these must be in conformity with, and not in opposition to, the present laws of nature, as otherwise they could not exist for us, seeing that "experience is possible in virtue of the original constitution of the mind," and therefore, according to the views of which Miss Naden is an exponent, they could not exist at all.

The most interesting of her essays are those which explain the system to which her editor Dr. Robert Lewins gives the name of Hylo-Idealism. This is described as the "brain theory of mind and matter," and it is so described because it asserts that every man is the maker of his own cosmos, all his perceptions having merely a subjective existence and being generated by the brain, "which focuses converging rays of sense from all parts of the body, and unites them into the white light of consciousness." It would be a mistake, however, to think that, according to this theory there is nothing outside of the percipient subject, that is, beyond man himself. The real existence of matter is not denied and, indeed, "so far from being a nonentity, matter is the *fons et origo* of all entities." Hylo-Idealism deals only with the relative, "ignoring the absolute as utterly beyond human *gnosis*." While asserting that "the only cosmos known to man, or in any way concerning him, is manufactured in his own brain-cells," it affirms the existence of another cosmos, the external universe of other systems. The mind does not however passively apprehend external objects, but actively constructs them. "We make the mountains, and the sea, and the sun himself; for sunshine is nothing if not visible, and if there were no eye and no brain, there could be no sunshine." The defect of this reasoning is that it makes man the only measure of all things. Because our senses are necessary to us to distinguish certain phenomena, it does not follow that the same phenomena cannot be distinguished under other conditions. The protozoa which have no organs of special sense are affected by the vibrations of light, sound, and probably smell, which would not be possible if those phenomena are "constructed" by the human mind.

The utmost that can be said with any show of reason is that the imaging in our consciousness of external objects does not give an actual representation of them. This is required by the theory of Hylo-Idealism, which goes still further, however, and declares that the universe does not exist as we know it. It seems to us that this view is not consistent with even the principles of Hylo-Idealism. Dr. Lewins specially points out that this system "in no sense denies the objective, but only contends for *identity* of object and subject, proved as it is by natural Realism itself, from the doctrine of *molecular metamorphosis*, which shows the Ego continually

undergoing transubstantiation with the 'Non-Ego,' and *vice versa*, so far as to form *one* indivisible organism." He compares the Ego and the Non-Ego, that is, subject and object, or our bodies and the "external universe," to a porous vessel of ice, filled with water, immersed in an infinite ocean. "What is within and without, and the septum that seems to divide the two, are all three consubstantial or identical." If they are identical, however, they must perfectly respond to each other, which would not be the case if the object in the mind did not give a true representation of the objects in external nature. Otherwise the identity of subject and object can be predicated, on the condition only of abolishing the "external universe," and affirming of it, as Dr. Lewins affirms of the stars, "What you see is a vision, or organic function, of your own *sensifacient* organism."

We have not space to critically consider Miss Naden's essay on "Evolutionary Ethics," which is a valuable study in Sociology. She gives logical form to Mr. Herbert Spencer's quasi-utilitarian system in the words, "the *inclination* is always in the direction most pleasurable or least painful; the *results* of the action, if it be a moral one, are such as in the long run and on a large scale, must increase happiness; but the *object* of the action need not be connected in the mind of the actor with any thought of happiness, personal or general." The practical objection to this view of moral conduct is the reference to *personal* happiness. This should be excluded altogether as an actual motive of such conduct where self is the chief object concerned. Here duty or virtue should be the guiding principle, as it should be ultimately in all moral conduct. This indeed is really admitted when it is said that rational utilitarianism "aims, not straight at happiness, but at the essential conditions of happiness." The weak point in Mr. Spencer's system of ethics is the origin it assigns for the altruistic sentiment. This is based in sympathy, the germ of which, says our author, is to be found in the fact that the ideal or "representative" world possesses an emotional aspect and therefore "the thought of a fellow creature carries with it the thought of his feelings." This thought is not necessarily, however, accompanied with an active feeling of sympathy. It requires some other influence to give it external expression, and this must be sought in the activity of the sexual instinct. Traced to this source we can understand how the altruistic sentiment may become instinctive, giving rise through parental and fraternal affection, to the higher love of country and of race, which in time will also become instinctive.

In taking leave of Miss Naden's work, we must say that, much as we disagree with its Hylo-Idealistic views, it deserves to be read by all who are interested in the search for the key to the great problem of nature. Its examination of the logical system of Kant is slight, and it is not surprising, therefore, that the name of the great German philosopher is omitted from among the precursors of Darwin. Miss Naden is in error, too, in describing Haeckel as a pronounced Materialist. He is no more so than was Darwin himself. Such mistakes were probably due to the bent of the mind of our authoress, whose too early death is a loss to the cause of truth and to humanity itself.

EMBLEMATIC MOUNDS AND ANIMAL EFFIGIES. By *Stephen D. Peet*. Chicago : American Antiquarian office.

The author of this work is well known, not only as the editor of the *American Antiquarian*, but as a careful explorer of aboriginal monuments in the Northwest. His attention has not been limited, however, to the results of personal observation ; he has utilised the researches of other explorers, and is thus able to present to his readers an amazing amount of information, which is rendered doubly valuable by the profuse use of maps and illustrations. The points which Mr. Peet has sought to bring out in his book are, that (1) the works described as effigies were imitations of the wild animals which were once common in the region where they are found, which is chiefly in Wisconsin and Ohio, and were also totemic in their character ; (2) the effigies were used for practical purposes, such as screens for hunters, guards for villages, foundations for houses, heaps on which sentinels were stationed ; (3) they embodied "certain superstitions and customs which are rarely found, but which are suggestive of the religious system prevalent in prehistoric times."

The consideration of the first and second of these points does not come within our province, but it will be interesting to see what light the curious monuments described throw on the religious ideas of the aborigines. Mr. Peet states that the location of the effigies gives the idea of the prevalence among their builders of a kind of nature-worship. They are closely associated with the natural features of the earth, "the streams and lakes, hills and valleys, woods and prairies," being overshadowed by them. The animals represented were divinities to the people, and the effigies were intended to be symbols of such divinities, associated for particular reasons with special localities. In support of this view, Mr. Peet refers to the fact that the "myths which fix upon scenes in nature are those which remind one of the animal divinities which were worshipped. The figure of the moose and the turtle and other animals have been recognised in certain strange and contorted figures in the rocks and mountains, and myths have been connected with them, the myth having evidently been made to account for the resemblances." The most remarkable example of this kind is the great serpent mound of Adams County, Ohio. Serpent mounds are found in various other localities, and usually they correspond with the natural features of the ground on which they are placed.

But if the effigies are to be regarded as symbols of a totemic animal-worship, it may be thought that they cannot be taken as evidence of the existence of nature-worship. Mr. Peet remarks, however, that the symbolism of Ohio was that of sun-worship, and the existence of this phase of nature-worship among the American aborigines is an important fact. It connects their religious ideas with those which were at one time almost universally prevalent in the Old World. The Sun as the source of life and energy was from an early date the object round which centered the religious ideas of the ancient world, and the serpent occupied a chief place as symbolical of the most important of those ideas. The veneration for deceased ancestors represented similar ideas with those embodied in sun-worship, and the animal

totemism of which the effigy mounds are symbolic was connected with the latter superstition through ancestral worship, the mythical ancestor being identified with the totem. If this is so, the study of the mythology of the aboriginal inhabitants of this country may be expected to throw light on the origin of Old World superstitions, and Mr. Peet may be congratulated on having done so much to make known the symbolical and other works which will soon be the only relics of an ancient and wide-spread race. Ω.

LIFE. By *M. J. Savage*. Boston: Geo. H. Ellis.

In this volume of sermons we have a most interesting series of studies on a subject which is probably attracting at the present time more intelligent interest than at any past epoch. The views entertained by Mr. Savage are so well known that it is not necessary to give any elaborate review of the present work. Among other themes he treats of the Nature and Origin of Life, Goodness and Moral Evil, Life's Meaning, Nationalism and other social dreams, Morality and Religion. Everywhere we find much material for thought, and, although from the very nature of the case many of Mr. Savage's conclusions will not be generally accepted, his words will be read with more than a passing interest.

His statement that right and wrong "are to be understood by studying the progress, the development, of the race, just as we find out any other truth," cannot well be contested by the advocate of any ethical theory. When he affirms this life "to be only manifestations as the years go by, out-blossomings everywhere of that life which is God,—the mystery and yet the explanation of all things," he expresses an opinion that most men who have given the subject serious thought will accept—subject only to the reservation that they are allowed to understand "God" in their own way.

The answer given by Mr. Savage, in his concluding discourse, to the question "What is it all for?" will meet with less acceptance. He remarks that all the theories which can be found as to the outcome of things are only variations of three chief theories: (1) that of a future life of rewards and punishments, the theory of Milton's "Paradise Lost"; (2) that of M. Comte, which is well named the religion of humanity; (3) that which regards *spirit* as having the pre-eminence over matter. As to the first theory, Mr. Savage declares it to be condemned by the intellect, the heart, and the conscience of men. He affirms that the second theory ends in *nothing*, and he endorses the statement of Mr. John Fiske, that "considered intellectually, such a theory puts the world to permanent intellectual confusion." Mr. Savage, therefore, accepts the third theory which "makes immortality a wholly rational thought." He sees the proof of it in the existence of the brain, the conscience, the heart of man, which "are prophecies, since they are the expression of the nature of things, and since they demand the perfect thought, and love, and right." Ω.

PROTOPLASM AND LIFE. By *Charles F. Cox*, M. A. New York: N. D. C. Hodges.

The first part of Mr. Cox's contribution to the study of what may be termed the literature of the interesting subject he discusses, treats of the Cell doctrine. He traces clearly the changes that have taken place in the protoplasm theory, to which that doctrine belongs, with particular reference to Doctor Beale's *germinal matter* and Prof. Huxley's *physical basis of life*. In his summary of conclusions, Mr. Cox shows that the original idea of the cell, as propounded by Schleiden and Schwann, has gradually faded away. As he states, the attention of the defenders of the cell doctrine has been forced from one position to another until it is fixed on a germinal point. The same fate has befallen Dr. Beale's ideal living matter, which if an actually visible thing is reduced to "a mere skeleton of his original bioplasm," an attenuated reticulum; while Huxley's physical basis of life, like his *Bathybius*, is relegated to the realm of the imagination. Thus there is "no one visible and tangible substance to which the name protoplasm is rigidly and exclusively applied." Mr. Cox's conclusion as to the nature of the *basal life-stuff* is that "the only admissible alternative is matter plus vitality or matter minus vitality." This brings us to "the impassable gulf between the not-living and the living"; which we would observe, however, might cease to be impassable if we could properly define the terms "matter" and "vitality."

The second part of Mr. Cox's *brochure* is devoted to a consideration of the spontaneous generation theory, and its relation to the general theory of evolution. Mr. Cox's personal conclusion is, that, to the better part of the scientific authorities, "the spontaneous generation theory is a necessary part of the general theory of evolution, but that no experimental evidence has as yet been produced in support of the belief in the occurrence of abiogenesis, and that therefore the evolution theory hangs upon a link of pure faith." Mr. Cox finds in the gap between lifeless substances and living forms the veritable "Missing Link." Ω

NOUVEAUX APÉRÇUS SUR LA PHYLOGÉNIE DE L'HOMME. By *Madame Clémence Royer*.

Extracted from the Bulletin de la Société d'Anthropologie for 1890.

Madame Royer, in this admirable memoir, taking for a text the fact that an Australian lizard was seen by M. de Vis walking on its hind feet, criticises severely Haeckel's genealogy of man, whose line of descent she declares to be distinct from that of the apes. The first terrestrial ancestors of man and of other anthropomorphous animals issued from pelagic forms of distinct origins, whose evolution had been parallel, but the human ancestors acquired the upright position in a phase of amphibious ichthyophagy, while the ape ancestors adapted themselves directly to an oblique position. This original difference of attitude adapted men from the first to an entirely pedestrian motion, and the apes to a life more or less arboreal, but neither men nor apes have had any terrestrial ancestor adapted to the horizontal position. Ω

LE MONDE COMME VOLONTE ET COMME REPRESENTATION. Par *Arthur Schopenhauer*. Traduit en Français par *A. Burdeau*. Tome troisième. Paris: Félix Alcan.

M. Burdeau's translation of the chief work of the renowned philosopher of pessimism is the only perfect translation into the French language. It is made with a scrupulous exactness, and its style is said to be as clear as that of Schopenhauer himself, "by which he is distinguished from all other German philosophers and is recognised as a disciple of Voltaire, Rousseau, and Chamfort." The present volume contains important appendices in which Schopenhauer recapitulated and developed various points treated of in the first edition of his work. We may refer particularly to the chapters on Instinct, Genius, Insanity, the Metaphysic of Music, and the Metaphysic of Love.

DIE HYPNOSE UND DIE DAMIT VERWANDTEN NORMALEN ZUSTAENDE. Vorlesungen gehalten an der Universität Kopenhagen im Herbste 1889. By *Alfred Lehmann*, Ph. D. Leipzig: O. R. Reisland.

This little book will in one respect be of special interest to psychologists. The author confesses in the preface that when he commenced his hypnotic investigations, he attempted to explain the facts under consideration by the Cartesian theory which hitherto, he says, had proved perfectly sufficient to explain the data of normal soul-life. What the author understands by the Cartesian theory appears from the following passage:

"The popular conception of the relation between soul and body is, that the 'soul' is a being distinct from the body and endowed with certain faculties. This conception is still defended by a certain, not very numerous school of philosophers whom we may briefly call Cartesians from the fact that their theory can be traced back to Descartes, although in the lapse of time it has been considerably 'modified.'"

In a word the Cartesian theory is the theory that still accepts the existence of a mythical or metaphysical soul-unity called the ego. Dr. Lehmann says:

"It was argued since 'I' in spite of a constant change of my consciousness, 'am in possession of the certainty that it is the same identical 'I' that has all these states, sensations, feelings, this 'I' or the soul must be a unity. And this unity must stand in a causal connection with the outside world, with the domain of nature in the widest sense of the word," etc.

It is perhaps exceptional that a teacher at a University of Protestant Northern Europe has been under the influence of Cartesianism, but it is highly commendable that he openly confesses his change of opinion because the facts under observation demonstrate its erroneousness. Dr. Lehmann no doubt will find that the normal phenomena of psychic life are by no means in accord with the Cartesian doctrine. Indeed by showing how the abnormal and normal states agree, he implicitly confesses that the theory that proves untenable for the former ought to be

regarded as untenable for the latter. We have instances of men who believe in the Cartesian doctrine, or at least by a natural predisposition have a tendency to believe in it, wavering in their belief, because the data of the normal states of psychic life so little favor the dualism of the great French philosopher. Now it almost seems as if the discoveries and the strangeness of hypnotic phenomena had contributed a great deal towards turning the tendency toward a monistic solution of the psychological problems back to the almost abandoned dualistic solution. We are fully confident that this reaction will not last, because in spite of all the strange mysteries that surround modern hypnotism, it will after all only find a satisfactory interpretation in some monistic conception.

Dr. Lehmann in abandoning the Cartesian theory, says: "The bodily and "psychical states are as a matter of experience given as two series intimately connected the one with the other. Their connection can be explained in two different ways: Either the phenomena of the one are effects of the other, or both series "are effects of one and the same unknown cause."

Dr. Lehmann considers either solution a priori equally acceptable, yet he favors the latter, which might briefly be called (although the author does not use the expression) "the agnostic solution." Dr. Lehmann characterises it as "*die Spinozistische Annahme*" and calls it Psycho-physical Materialism.

One of his colleagues, Professor Kroman has proposed in his "Logik und Psychologie" a theory that is called by the same name. Yet Kroman's psycho-physical materialism, Dr. Lehmann declares, is widely different from his own; the former being "a mutual causal relation between the Physical and Psychical within the limits of the Atom," which, says Dr. Lehmann, "would make the explanation of complex psychical phenomena impossible."

The psycho-physical materialism of Dr. Lehmann, our author maintains, agrees in all essential points with the views of Professor Münsterberg (Freiburg in Baden).*

The laboratory work done by Professor Münsterberg was published after Dr. Lehmann had finished his lectures. A certain similarity between Dr. Lehmann's views and those of the Freiburg Professor cannot be denied, yet it is more than doubtful whether Professor Münsterberg would recognise this similarity in the same measure as Dr. Lehmann does. The fact is that Dr. Lehmann has progressed in the direction which the German school of Wundt has taken; yet he has not as yet reached the same clearness; he is still entangled in Cartesian ideas, as is shown by his way of proposing problems: for instance in his treatment of the problem of will, which he justly calls "*der eigentliche Probestein der Hypothese*," and of Attention, "the most enigmatic of all states of the soul" (*der räthselhafteste aller Seelenzustände*). In these and in other considerations Dr. Lehmann shows that he

*The observations of Professor Münsterberg were reviewed in *The Open Court* No. 134.

is still far from the positive standpoint by which Münsterberg's investigations are distinguished. It is very strange that in speaking of Attention M. Ribot's name has not even been alluded to. If the author had shown a familiarity with some of the monographs of this great French psychologist, he might have saved himself much work.

KPS.

DER HELIOTROPISMUS DER THIERE UND SEINE UEBEREINSTIMMUNG MIT DEM HELIOTROPISMUS DER PFLANZEN. By Dr. J. Loeb. Würzburg: Verlag von George Hertz.

The object of this work is to fill a gap in the treatment of the subject of animal movement depending on light, and to explain it by a consideration of the actual facts. After stating that the effect of light upon animal movement is purely mechanical, and that it is governed partly by the action of the light as the exciting cause, and partly by the structure of the sensitive organisation, Dr. Loeb proceeds, "I will now prove that the direction of the light rays determines quite generally the movements induced in animals by the light, no less than the direction of plant movement, and that the orientation not only of plants but of animals, depends upon the bodily form of the latter, in so far as the dorsiventral animals themselves move with the median plane in the direction of the light rays," etc. The more refrangible are the rays of light the more efficacious is its mechanical action upon animal and plant movement, which is affected also by the constant intensity of the light and its temperature. Thus it appears that the moth's flight into a flame must be considered as the same mechanical process as, for instance, the motions of sunflowers, the growth of the sprouting axis in buds, etc. Dr. Loeb's conclusion that the circumstances which govern the movements of animals towards the light are conformable to those which have been already recognised in relation to plant-movement, is supported by numerous facts, which appear to fully establish the accuracy of his observations and deductions.

The diligent author who is at present engaged in scientific investigations at the *stazione zoologica* in Naples, has in the mean time published a series of further observations on the same question, all of which, as was to be expected, corroborate the propositions set forth in the above mentioned little book. We have before us two reprints, one from the *Biologische Centralblatt*, Vol. X, Nos. 5 and 6, 1890, the other the *Archiv f. d. ges. Phys.*, Vol. XLVII, with one plate and two wood-cuts, the former treating of the heliotropism of the nauplii of *Balanus perforatus*, whose periodical migrations are shown to depend upon the action of the light, the latter discussing the common features of heliotropism in animals and plants.

UNTERSUCHUNGEN ZUR PHYSIOLOGISCHEN MORPHOLOGIE DER THIERE. I. UEBER HETEROMORPHOSE. By Dr. Jacques Loeb. With 1 plate and 3 figures. Würzburg: George Hertz.

Julius von Sachs, Vöchting, Noll, and other botanists have successfully opened the way to a knowledge of the growth of plants in their causal conditions. This

method has been applied to the physiology of animals by Pflüger. The present pamphlet is a contribution to this endeavor by Dr. Loeb, whose special object has been to determine the laws of the restoration of lost organs in animal organisms. Botanists have found that if a plant that has undergone the loss of an organ has to build it up again, the new organ will be different from the original organ, and this difference can be determined by law. Dr. Loeb inquires whether the same can be said of the reconstruction of the lost organs of animals.

There are, as a rule, in animal organisms two poles, viz. the oral pole, forming the head, and the aboral forming the tail. It has been generally supposed that living animal substance possesses the tendency to develop in one special direction oral organs, and in the other aboral organs. This was called Polarity and is based upon the experiments of Allman, Trembley, Dalyell, and others. The experiments of Dr. Loeb, made with the view of testing the polarity theory, show that it is possible to develop in animals possessing physiologically distinct heads and tails, heads instead of tails in the aboral pole, and to do so without any serious interference with the vitality of the creature. The experiments have been made chiefly on *Tubula in mesembryanthemum*, *Aglaophenia pluma*, *Plumularia pinnata*, and other species.

Dr. Loeb proves by his experiments that external conditions control the reproduction of organs, so that artificially oral organs can be made to grow where aboral organs have been, and *vice versa*. It is this faculty of animal organisms which Dr. Loeb calls *heteromorphosis*.

KPG.

DIE ETHISCHE BEWEGUNG IN DER RELIGION. By Stanton Coit, Ph. D. Uebersetzung von Georg von Gizycki. Leipsic: O. R. Reisland.

This series of Sunday lectures by Dr. Stanton Coit, the speaker of the South Place Ethical Society of London, England, has been translated into German, in the shape it is now before us, by Dr. Coit's friend and teacher Prof. George von Gizycki; they have not yet appeared in English. The South Place Ethical Society is not directly affiliated to the Ethical Societies of North America, but it stands with them in friendly relations. Dr. Coit, a native American, is strongly biased in his views by his American co-workers; he is the youngest among them, and is, I believe, to be considered as a disciple of Professor Adler. He has inherited from Professor Adler the idea that we can have ethics without a world-conception or areligion; yet this idea has been considerably modified, and an approach to more positive and practical views is perceptible in many passages of his sermons.

In the lecture "Which Ethics?" Dr. Coit says: "We need (*bedürfen*) a theory concerning the universe and our position in it instead of the old faith." Yet in contradiction to this, he declares that theories are of little use. He adds: "If two men come down from their abstract theories into real life and to the forces which create action, it is as if they descend from two opposite mountain peaks into a warm and rich valley where rivulets run down from both sides to unite their waters inseparably into one continuous stream."

Is not this beautiful allegory, true as it certainly is in one sense, after all misleading? Is not theory and theory different? If theory means mere speculation, we heartily agree with the proposition to keep clear of and far away from theorising. It is at best a harmless play, and certainly a loss of valuable time. Yet if theory means methodical systematisation of facts, it is not mere waste of time; in that case it is the indispensable condition of all truly practical work. And it is this latter kind of theory which also in the practical work of ethical culture must be sought to be established. We must at least be clear as to basic principles so that the efforts of ethical teachers may not be at random, but directed by the progressive spirit of the age in harmony with our best scientific and philosophic thought.

Concerning religion Dr. Coit says (p. 19) in his article "Why Ethics Instead of Religion": "My own opinion is that there is one feature which distinguishes Religion from all other doctrines, ceremonies, and rules. This feature characterised Matthew Arnold's view. For he insisted not only upon morals and their importance, and thought of means for their propagation, but he proclaimed also that there was a power above the will of man to which he must bow. In the very moment he proposed that power which we have to obey, his ethics became religious. . . . But the recognition of this higher power, if I am allowed to propose my own views, appears to me of very little importance."

If there is such a power, and we have sufficient reasons not to doubt its existence, I should say that for ethical purposes it is of paramount importance to recognise it and to obey it. In another and a more recent lecture, Dr. Coit pronounces a very different view, he says:

"Anybody who has ever reflected a moment, must have discovered how dependent he is upon a power outside of his own will. He has no strength either for good or for evil, which he has made himself. The more he thinks about it, the deeper must become the feeling of his dependence. And being aware that God, or whatever we call that power in all things, does not mind his whims, he will find it easier not to mind, himself, his own whims. The constant thought that we are not the powers of life and death, will take away conceit and vanity and foolishness. And in this way, it brings us in times of tribulation to a quick resignation. It makes us loving brothers and sons."

Dr. Coit indeed aspires to make of ethical culture a religion for the people. He speaks on this subject in his last lecture. He opposes the Churches for mixing their ethics with theology, and he speaks with great enthusiasm about the poetry of ethics, which is much more powerful than the prose of ethics. He does not seem to see that the influence of the churches is mainly due to their poetry of ethics. Would it not be advisable to point out the prosaic truth in this poetry for the purpose of freeing the human mind of the obnoxious elements of a misunderstood poetry? Would it not be advisable to investigate the poetry of the basic idea in ethics, viz., of the God-idea, so as to let the ethical movement develop itself his-

torically from the past. Dr. Coit's method of dealing with the God-idea is far from satisfactory. He is neither a theist nor an atheist. Sometimes he appears to appreciate the moral importance of the God-idea in its purified shape, and then again he seems to consider it as an ethically indifferent idea. Should not this problem be settled by every one who undertakes to preach ethics. It appears almost as if all the leaders of the ethical culture societies underrated the ethical importance and indispensableness of thought in general and of science and philosophy in particular.

The contradictions which appear in Dr. Coit's lectures show that he is still developing. The book is full of promise and we have every reason to hope that its author will overcome the uncleanness that is still lurking in his mind, and that he will grow with the work he is doing.

KPC.

FREMDES UND EIGENES AUS DEM GEISTIGEN LEBEN DER GEGENWART. By Prof. Dr. Ludwig Büchner. Leipsic: Max Spohr.

Opinions admittedly are still divided with respect to the laudable efforts of a large class of scientists and writers whose main object is that of presenting the results of scientific research in an intelligible, popular form. Every department of the natural sciences, geology, astronomy, even psychology and comparative philology, each and all, are now represented by able and ardent popular interpreters, who at the same time by their aggressive style and by their polemical methods not unfrequently seem to impart a kind of militant and apostolic attitude to the cause of science. It must further be admitted, that many of these writers, by the unanimous verdict of the present age, are among the most instructive, readable, and actually the most widely read authors of contemporaneous German, French, and Anglo-American literature. At first glance, it accordingly may seem rather strange, that these same popular authors should also be subjected, not unfrequently, to their commensurate share of unfair, and even offensive, popular criticism; and yet it could hardly be otherwise.

The well-known writer of these scientific and critical essays, Prof. Ludwig Büchner, affords an exceptionally striking instance of the unenviable lot of some of our most popular writers of science. In one of these essays inscribed "Meine Philosophie," Professor Büchner has been compelled to defend the arduous work of his laborious life against a decidedly unfriendly and unappreciative criticism of his philosophy and whole scientific activity, that some time ago appeared in the American *Freidenker* of Milwaukee. Prof. Büchner, with a touch of legitimate bitterness, repudiates the imputation of having been, or still being, as he himself calls it, only the "popularisator," expounder and commentator, of the theories and systems of other thinkers; that, on the contrary, in Germany and elsewhere, among the highest representatives of science, for more than thirty years Professor Büchner himself has been recognised and honored as an original worker and thinker. His book on "Force and Matter" (*Kraft und Stoff*) was published five years before Darwin's great work on the "Origin of Species." Subsequently his well-known

popular Lectures in connection with Darwin's work claim the distinguished merit, of having more widely generalised and extended the Darwinian theory by embracing the origin and evolution of man, which had until then been overlooked by Darwin himself. By the contemporary press of Germany Professor Büchner was then charged with premature rashness, and with being only a shallow, imitative scientific dilettante; but all this vituperative criticism was for ever silenced, when in the year 1871 Darwin's own work appeared on the "Descent of Man," in which Darwin himself accepted all the consequences of the theory of evolution, as set forth in Professor Büchner's Lectures, and, somewhat later, in Professor Haeckel's "Natural History of Creation" (*Natürliche Schöpfungsgeschichte*). Professor Büchner, moreover, is the author of the widely popular work "The Future Life and Modern Science" (*Das künftige Leben und die moderne Wissenschaft*). To deny him, accordingly, the rank and merit of a solid and original scientist and thinker, as he himself says, is to do him a signal injustice, a positive injury.

Let all this be willingly granted; but this concession, at all events, does not settle his final, mediating attitude to the entire satisfaction of philosophy, regarded as an independent science. Professor Büchner openly declares himself in favor of popular science. He maintains, that "Philosophy ought to step down from her lofty state of independent science, and henceforth content herself with the humble rôle of simply mediating the results of individual scientific research; that science, in such case, would no longer run the risk of being exposed to the scorn and contempt of the masses(!) . . . In popular scientific writings, at all times, there can and must occur contradictions, superficial estimates, even trivialities, but all this is perfectly understood by any fair-minded reader." . . . These remarks might almost tempt the reader to believe, that Professor Büchner, in his eagerness to popularise science, really ignores the value of philosophy as an independent science, and of philosophical research, irrespective of all popular results, and that the Professor wishes to inculcate a narrow and purely utilitarian estimate of philosophy. But, the impulsive Professor, of course, knows better; his mental vision embraces the entire field of the sciences, and he has written admirably and entertainingly upon almost every scientific topic, and moreover he admits, that possibly he sometimes contradicts himself.

One might further be inclined to ask, whether, in view of his self-imposed, familiar contact with the popular mind, Professor Büchner upon the whole displays the expected equanimity and broad-minded consistency when resenting the harsh criticism of antagonists, which he does with a singularly thin-skinned sensitiveness scarcely worthy of a true philosopher. In all his other works and throughout these critical essays, Professor Büchner himself shows no tender regard for the feelings of his philosophical antagonists. In the critical essay "Against Materialism," (*Wider den Materialismus*), for example,—mainly directed against Prof. Harald Höffding,—he bluntly affirms that Professor Höffding's works have produced upon him the impression that the author is a man without the philosophical and scien-

tific knowledge requisite for the solution of the problems he has ventured to approach.

From what has been said, the reader may expect to find much important, instructive, and readable matter even in Professor Büchner's critical essays, bearing upon the intellectual life of the period; but he also must be prepared to find them leavened in no small degree with the characteristic mental idiosyncrasies of their ever polemical author.

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DEACON HERBERT'S BIBLE CLASS. By *James Freeman Clarke*. Boston: Geo. H. Ellis.

This booklet is an unassuming little publication, but it is important as a symptom of the times. It was written by the late Mr. James Freeman Clarke many years ago as a series of papers for the *Christian Inquirer*. Yet it is well that they should not be forgotten and the lessons contained therein should be heeded by the clergy as well as the laity of this country. It is an attempt to make religion practical and to point out the true direction in which church-life has to develop.

There is a great truth in the general complaint made throughout the world that the religion of civilised mankind, especially Christianity in the shape it exists at present, has lost its life, its influence, and its usefulness. Our religious views must be transformed, they must be reconciled with the principles of science and must be adapted to the real needs of the people. The problem is, how to do it.

If a solution of the problem shall be found, it is certain that it will be first put into practice in the United States of America; for here the church is free. The many different churches of our country, with few exceptions (the Roman Catholic Church is perhaps the only one) are in principle churches of the people. A change of opinion, of belief, of religious conviction among the people will result in the appointment of such pastors and leaders as are in agreement with their congregations. Clergy and laity form here one organic body. The clergy are not imposed upon their congregations by the state; they are the exponents of their congregations, the representatives of the religious ideas (perhaps upon the whole of the conservative religious ideas) of their churches.

How different things are in Europe, where the state-churches of England and Germany, for instance, prevent all progress in religion, theology, and church-life.

Mr. Clarke's book, if read with these considerations in mind, shows the agencies that are at work in this country and that will (as we confidently hope) result in a new phase of religious life. Among the chapters of the book we note the following titles: "The way we helped our minister to write good sermons"; "Aim of Life"; "Temptation of Jesus"; "The Miracles"; "The Sermon on the Mount"; and others. The spirit in which the book is written is not exactly rationalistic, yet it shows in every line a strong monistic bias. For instance, the usual definition of miracles as a suspension of the laws of nature is discarded; and yet it would be erroneous to suppose that the style of the book is marked by a radical tendency. Not

at all. Every faithful Christian can read it line for line without feeling the least offence. But it is plain that herein lies the author's force. The book is popular, but behind its popularity, unusual depth of thought is noticeable. In a similar way St. Paul gave milk to his followers because they were babes in Christ, and could not bear heavier food. Mr. Clarke's book is written especially for babes in Christ, yet every one who has given any serious thought to the religious problem will appreciate at once the difficulty and the importance of such an undertaking.

KJG.

PERIODICALS.

THE AMERICAN JOURNAL OF PSYCHOLOGY. September,
1890. Vol. III. No. 3.

CONTENTS:

- ON THE BRAIN OF LAURA BRIDGMAN. By *H. H. Donaldson*.
A SKETCH OF THE HISTORY OF REFLEX ACTION (II). By *C. F. Hodge*.
ON A CURIOUS VISUAL PHENOMENON. By *Joseph Le Conte*.
A COUNTING ATTACHMENT FOR THE PENDULUM CHRONOSCOPE. By *William Noyes*.
PSYCHOLOGICAL LITERATURE. The Nervous System—by *H. H. Donaldson* ;
Experimental Psychology ; Criminology—by *Arthur MacDonald* ; Psychiatry
—by *William Noyes* ; Miscellaneous.

The full title of Dr. Donaldson's elaborate article is *Anatomical Observations on the Brain and Several Sense-Organs of the blind Deaf-Mute, Laura Dewey Bridgman*. The object had in view in the examination of the brain was "to determine, if possible, whether the peculiar mental existence of Laura Bridgman, which was the result of her defective sense-organs, has left any trace on her brain, or whether such anomalies as may be observed are sufficiently explained when considered as the direct consequences of the initial defect alone." The article is therefore "a special study in the general field of the inter-relation of brain-structure and intelligence." The final results are reserved for a second article, but it appears from the present one that the total area of Laura's brain is somewhat small for its weight, and that it is slightly inferior to two other female brains with which comparison was made, the inferiority depending mainly on the smaller average depth of the sulci, that of the left side being the most manifest. The difference can be explained in part at best, by the failure of certain portions of the brain to develop completely. Dr. Donaldson's article is illustrated by very carefully prepared plates.

In the present part of his sketch of the history of reflex action, Dr. Hodge treats of the law demonstrated by Bell, that the *posterior roots of the spinal nerves are sensory, the anterior motor*, which forms the beginning of the modern history of the nervous system, and of "the physical versus the psychic theory of reflex action." The mechanical theory of reflex action was first elaborated by Marshall Hall. It was opposed by Volkmann and others, among them Pflügel and Auerbach. On the other hand, Lotze supported the former view, but he advanced "a step beyond the comparatively crude, simple mechanism of Marshall Hall to a mechanism of the utmost delicacy, a mechanism susceptible of the nicest adjustments, capable of education, and of prolonged, independent, and complex activity." Habit is only another name for mechanism.

Under the head of Psychiatry, Dr. William Noyes gives an elaborate sketch of the life of Jean Jacques Rousseau bearing on the question of his insanity, which is exciting considerable interest at the present time. (E. C. Sanford, Clark University, Worcester, Mass.)

MIND. October, 1890. No. LX.

CONTENTS:

- THE ORIGIN OF MUSIC. By *Herbert Spencer*.
 MENTAL ELABORATION. By *James Sully*.
 VOLKMAN'S PSYCHOLOGY (II). By *Thomas Whittaker*.
 BERKELEY AS A MORAL PHILOSOPHER. By *Hugh W. Orange*.
 MUENSTERBERG ON 'MUSCULAR SENSE' AND 'TIME-SENSE.' By the *Editor*.
 DISCUSSION: 1) Mr. Spencer's Derivation of Space. By *Prof. John Watson*.
 2) Dr. Pikler on the Cognition of Physical Reality. By *G. F. Stout*.
 CRITICAL NOTICES: Lewis's "A Text-Book of Mental Diseases." *Mercier's*
 "Sanity and Insanity"; Jones's "Elements of Logic as a Science of Propositions";
 Coupland's "The Gain of Life and other Essays."
 ON THE UTILITARIAN FORMULA. By *James Sutherland*.

The Origin of Music. This article is intended as a postscript to Mr. Spencer's essay on "The Origin and Function of Music," included in his *Essays, Scientific, Political, and Speculative*, of which he is preparing a final edition. It is a reply to Mr. Darwin, who supposes music to have originated from a particular class of vocal noises, the amatory class, instead of, as Mr. Spencer asserts, its being derived from the sounds which the voice emits under excitement, eventually gaining this or that character according to the kind of excitement. After considering various objections by Mr. Edmund Gurney and others, Mr. Spencer concludes: "The origin of music as the developed language of motion seems to be no longer an inference but simply a description of the fact."

Mr. James Sully deals with Differentiation, Assimilation, and Association as the intellectual constituents in the process of Mental Elaboration. Differentiation is considered first as a process of marking off, by means of special adjustments of attention, particular sensations; followed by Discrimination, which involves change of psychical state, the dependence of mental life on which has been formulated as the Law of Relativity. Assimilation, described as a mode of unification or integration, is treated of under the headings, *Psychological Nature of Likeness; Automatic Assimilation; Recognition; and Transition to Comparative Assimilation*. Association is the "process of psychical combination or integration which binds together presentative elements occurring together or in immediate succession." This supposes *Retention* or the tendency of a sensation to persist, and *Reproduction*, or the reappearance "in consciousness" of the impression under a new representative form. The three processes of Differentiation, Assimilation, and Association do not follow each other, but are closely interconnected.

Part II. of *Volkman's Psychology* deals with the problem of Time and Space, and with the subjects of Space of Time (*Zeitraum*), Motion, Number, and Intuition. "Out of sensations intuitions are evolved in consequence of the properties immanent in the sensations." While their localisation progresses in the region of the more strongly toned sensations, projection, or the "assignment of sensations to the external world," goes on simultaneously in the region of toneless sensations. By the addition of "consciousness of dependence in having the sensation," there is the completion of the presentation of the External Thing as *thing*. Illusions are divided into two classes; namely, 'illusions of internal perception' and 'illusions of sense.' The Ego is purely a psychical result of the soul "becoming conscious of an interaction between one of its presentations and the most ramified of its presentation-masses." Self-consciousness is defined as "internal perception within the Ego."

The mind is then dealt with as thinking, feeling, desiring, and willing. Ethical feeling is a kind of æsthetic feeling, distinguished from others by the peculiarity of its objective basis, which is the actual will of the subject. Moral freedom is to have the will determined by reason. Psychological freedom permanently extended over the whole of volition is Character; its opposite is Passion.

Mr. Orange furnishes a different explanation of Berkeley's ethical system from that given by Professor Fraser, in a note to the third dialogue of *Alciphron* (ii. 107), and points out its agreement with Berkeley's *Principles of Human Knowledge*. "Moral laws are laws of nature; but there is no value or force in them as laws, save in so far as they are the orderly expression of God's ideas." Man's ideas are true or good, when the human spirit is at one with the divine. Both in natural and moral philosophy the laws of nature are to be attained by the use of reason.

Prof. Robertson draws attention to the concessions involved in Münsterberg's idea of 'Muscular Sense.' To the term 'muscle-sensation' no exception can be taken, "provided it is meant for no more than mere external designation, as when we speak of 'eye-sensation,' 'skin-sensation,' or the like," and is not called 'sensation of movement.' Münsterberg finds that a whole class of factors have been overlooked, or hardly regarded, by previous inquirers into 'Time-Sense.' These are sensations (or representations) of muscular tension, by synthesis of which with sense-elements (sounds by preference) time-apprehension is explicable. He is struck particularly with the part played in his experiments by the breath-rhythm, and "it seems impossible to doubt that breathing has a prerogative position among the sense-factors concerned in the estimation of short time-intervals." The name 'Time-Sense' has through Münsterberg's investigations "more justification than it ever got from its inventors, for whom it has marked only the apparent immediacy of time-apprehension."

In his criticism of Mr. Spencer's theory of the derivation of space Prof. John Watson lays down as the fundamental position of Transcendentalism, or Idealism, as he prefers to call it, "that the universe is intelligible, and that man in virtue of "his intelligence is capable of grasping it in its essential nature. It therefore rejects as unmeaning the doctrine of Mr. Spencer, that we know reality to be unknowable." While recognising that Mr. Spencer and others have done good service in drawing attention to certain outward aspects of the evolution of mind, Professor Watson "concludes that no psychology can be adequate which does not recognise that perception is not the mere occurrence of transient feelings, but the first step in that recognition of the true nature of reality which culminates in the comprehension of the world as a single organic unity of which the source and explanation is intelligence."

Mr. Stout points out, in reply to Dr. Pikler (*Mind*, No. 59), that the sole aim of his article on "The Genesis of the Cognition of Physical Reality" (*Mind*, No. 57) was to trace "the genesis of the presentation of physical reality as it appears to the ordinary consciousness: not as it may be modified, and perhaps rectified, by the reflective criticism of this or that philosopher," and that what he urged against Mill was simply that "he has confounded his own philosophical view of physical reality with the view which men ordinarily take when they are not in a philosophical mood."

It is shown by Mr. Sutherland that in the utilitarian ultimate conception there is, in addition to "the greatest happiness, *plus* an arithmetical truth," the element of absolute justice, the existence of which requires that "all subsidiary rights as means to greatest general happiness should at utmost be classed under relative justice." (London: Williams & Norgate.)

INTERNATIONAL JOURNAL OF ETHICS. October, 1890.

Vol. I. No. 1.

CONTENTS:

- THE MORALITY OF STRIFE. By *Professor Henry Sidgwick*.
 THE FREEDOM OF ETHICAL FELLOWSHIP. By *Felix Adler, Ph. D.*
 THE LAW OF RELATIVITY IN ETHICS. By *Professor Harald Höffding*.
 THE ETHICS OF LAND TENURE. By *Professor J. B. Clark*.
 THE COMMUNICATION OF MORAL IDEAS AS A FUNCTION OF AN ETHICAL SOCIETY
 By *Bernard Bosanquet, M. A.*
 DR. ABBOT'S "WAY OUT OF AGNOSTICISM." By *Professor Josiah Royce*.
 A SERVICE OF ETHICS TO PHILOSOPHY. By *Wm. M. Salter*.

This is the first number of the *International Journal of Ethics*, which is intended to take the place of the *Ethical Record*. In the opening article, Professor Sidgwick affirms that the idea of a universal and complete harmony of the earthly interests of all human beings is "an optimistic illusion as to human relations, which in the present age of the world has nearly faded away." Nevertheless, "a very substantial gain would result if we could remove from men's minds all errors of judgment as to right and wrong, good and evil, even if we left other causes of bad conduct unchanged." What is practically wanted is improvement in moral insight, and the aim of the paper is to aid in the solution of certain intellectual difficulties which arise when we try to get a clear idea of duty. Warfare among modern nations "is normally not a mere conflict of interests, but also a conflict of opposing views of right and justice." Disputants may therefore be brought into harmony if they can be really and completely enlightened as to their true rights, as distinguished from their interests. The international law administered by arbitrators may be most useful "in removing minor occasions of controversy and in minimising the mischief resulting from graver conflicts," but it will not provide a settlement of all occasions of strife. Where the sphere of arbitration ends that of the moral method of attaining international peace begins; "if we must be judges in our own cause, we must endeavor to be just judges." The impartiality required is difficult, but "the judicial function—which, in a modern state under popular government, has become, in some degree, the business of every man"—might be performed with success, "if national consciences could be roused to feel the nobility and grapple practically and persistently with the difficulties of the task."

Professor Adler's article is devoted to an account of the Ethical Societies, which are described as being "consecrated to the knowledge of the Good, but not to any special theory of the Good." To adopt a philosophical formula as the basis of union would be to become a philosophical sect, which he declares is "the most contemptible of all sects, because the sectarian bias is most repugnant to the spirit of genuine philosophy." The accepted norms of moral behavior form the starting points of Ethical Societies and their basis of union. They build on the common stock of moral judgment, which may be called the common conscience. Ethics is both a science and an art. As a science it has to explain the facts of the moral life, and it is necessary to begin with the facts and to test theories by their fitness to account for them. It is "the prime duty of every one in his individual capacity to rise to the ever clearer apprehension of first principles," but for this very reason Ethical Societies in their collective capacity abstain from laying down any set of first principles as binding.

It is not quite clear how Professor Adler can declare that the Ethical Societies

are consecrated to the knowledge of the good, and yet make so strong an opposition to their stating such knowledge in the exact terms of a philosophical formula. Philosophy is nothing but knowledge of the world systematised into a world-conception. It will hardly be sufficient to make the "common conscience" the corner stone of any society devoted to the elevation of morality. Not only would it be difficult to ascertain what that "common conscience" at present is, but, in addition, we can be assured that the "common conscience" is constantly changing.

Ethics as a science means philosophical ethics; and Professor Adler's ethics is, in fact, the expression of a philosophy. Yet in spite of the advanced position of the Ethical Societies, which have discarded all religious views and ceremonial practices, we find that their leader still stands upon the ground of a dualistic extra-naturalism. Professor Adler says:

"There is a reality other than that of the senses, and the ultimate reality in things is, in a sense, transcending our comprehension, akin to the moral nature of men. But how shall we acquaint ourselves with this Supersensible. The ladder of science does not reach so far."

It is true that there are realities other than that of the senses; take as a most simple instance mathematical points and lines. But there is no reality which theoretically considered can not become an object of science. The statement that there are facts to which the ladder of science does not reach, is tantamount to a declaration of supernaturalism and dualism. Professor Adler has discarded the terminology of the old dogmatism, but he has not discarded its basic error. Instead of developing the old faith into a monistic religion, he throws away religion as a basis of ethics, but preserves carefully that element in it which is hostile to science and philosophy.

The *Law of Relativity* is a very important contribution by Professor Höffding to the Science of Ethics. After stating that the moral law, if it is to be truly universal, must "only judge the general direction of the *tendency* of the will," he affirms that the individual relativity of ethics, or its personal equation, is a factor which enters into the ethical question, "when different individuals with like ethical principles and in like circumstances, but with different dispositions and capacities have to be considered." The individual is always a part of society, and the life of society is no other than that contained in its members, the ideal being "reached only when the individual's efforts in the cause of society also serve the free and harmonious development of his own faculties and impulses." In an ideal State only that would be demanded of each individual which lay within his range and power. Self-control, as a negative virtue, is a psychological impossibility. It is necessary to take note whether there is room for other inclinations that could absorb the store of energy. The struggle of self-control lasts until the new application of energy gains complete ascendancy. The happiest man is where morality has become organic and "there is an agreement between the task arising from the general principles and the particular circumstances, and the capacities and desires of the individual." Professor Höffding objects to the views of the Italian *criminal-psychological* school that atavism is a sign of social imperfection, that it "does not justify placing society and the criminal over against each other as absolute right and absolute wrong." He concludes that it is at least an open question whether there are any human beings "in whom no sympathy for the moral law can be awakened, however much the law may be individualised."

The arguments of Professor Clark on *The Ethics of Land Tenure* are summed up in the following passage: "If a state originally owned its land, in the fullest

sense of the term, it had the right of voluntary alienation which is inherent in such ownership. Increments of value, present and future, are its property; in alienating them it gives away its own. If the attainment of its ends requires that they be transferred to others, the title of the grantees is valid. To deny to the state the privilege of alienation is to essentially abridge its natural rights; it is to make its ownership of the land incomplete." In relation to what is incorrectly termed "unearned increments," it is remarked, "if the essence of property is regarded, and not its form, the increments of value attaching to land are not unearned by their proprietors. In an active market land has its fair price, and this is based partly on the future increments themselves." The loss arising from a confiscation of land-value would fall "not merely on millions who have titles in fee simple, but on all who have made loans on land as security. . . . To every one it would come in the shape of a seizure by the state of property invested in accordance with its own positive invitation."

The communication of moral ideas, and not ideas about morality, which are the abstract or scientific renderings of moral ideas, is considered by Mr. Bosanquet as the proper function of an Ethical Society. The fault of the present time is distraction, and "one great cause of this distraction is the notion of a general duty to do good, or something other than and apart from doing one's work well and intelligently." The only certain way of communicating moral ideas is contagion, and the most useful teacher of morality is "not so much a man of abstract theory as a man of reasonable experience."

Ethics may be of service to philosophy, says Mr. Salter, in opening up the realm of "what ought to be," beyond the realm of "what is and happens." Moral ideas belong to the realm of unverifiable ideas, which are believed in because of "their own intrinsic attractiveness and authority." Ethics tells us of the law according to which men should act, the law of justice and brotherhood; we may conclude "that whatever may be the actual forces in the world at any time, justice and love are rightfully supreme over them all, and that these are so interwoven with the order of things that nothing out of harmony with them can long stand." It is "the imperishable glory of transcendentalism in our country that in the decay and disintegration of the ancient creed," it sounded the high-note "that the soul can in some sense know the object of its worship; that it need not feed on hearsay, and tradition, and arguments, but can have vision." (Philadelphia: *International Journal of Ethics*, 1602 Chestnut St.)

REVUE PHILOSOPHIQUE. September, 1890. No. 177.

CONTENTS:

REMARQUES SUR LE PRINCIPE DE CAUSALITE. By A. Lalande.

PHILOSOPHES ESPAGNOLS.—J. HUARTE. By J. M. Guardia.

LES ORIGINES DE LA TECHNOLOGIE (*fin*). By A. Espinas.

UN DOCUMENT INEDIT SUR LES MANUSCRITS DE DESCARTES. By V. Egger.

NOTICES BIBLIOGRAPHIQUES.

REVUE DES PERIODIQUES ETRANGERS.

The principle of causality belongs only to the world of sense, that of children and of the commonality of mankind who neither reflect nor analyse their knowledge. It represents confusedly the continuity and inertia which are proper to the scientific stage, as colors represent imperfectly the undulations of the ether, and

sound the vibrations of ponderable matter. To make of causality a scientific property of things, a law of the phenomenal and mechanical world, is to affirm that bodies preserve their color in the absence of an eye to perceive it, or their sonorosity when no one hears them. Moreover, from a scientific standpoint, the words sound and color lose all proper meaning; while the principle of causality retains a sense, but then expresses a false proposition, and one which leads us incessantly into error. Several consequences flow from M. Lalande's conception of causality. The first is that this law is not a rational principle, but is an *empirical* formula, in the mathematical sense of that word. The second is that we are thereby led to see in the idea of *efficiency* an artificial concept, and, as would be said by philologists, a disease of language, instead of a mysterious "power" that emanates from one phenomenon in order to create its effect. A third consequence is the great simplification it leads to in the problem of induction, which requires us merely to believe in the stability of the laws of nature, which are only mathematical laws proved by experience. The true foundation of induction is the universal value of mathematics, which rests finally on the principle of identity. The degree of perfection of a science can be measured by the quantity of mathematics it employs; and it is this preconceived idea which has given birth to all the psycho-physical measures that have been recently introduced into psychology.

M. Guardia's paper gives a sketch of the philosophical system laid down in the work of the Spanish writer J. Huarte, *The Trial of the Spirits*, with an introductory account of the author and his book, which first appeared in 1575. Huarte is described as unique among Spanish thinkers, and as a leading figure among natural philosophers on account of the daring novelty of his original views and the excellence of his method, which is that of the inductive philosophy. His doctrine is founded on that of Galen, and he proclaims the principle that the physical determines the moral. All his metaphysics reduce themselves to the recognition of the action of exterior causes, which are of inorganic nature, and of the organism which reacts to them. He thus explains all the manifestations of life, heredity intervening as a factor in its evolution. Huarte was less concerned, however, with physiology and psychology, than with the amelioration of the social state. He worked for the future by creating of psychology an organic science of observation and experience, founded on the knowledge of human nature, and by basing on it the art of education.

In concluding his valuable study of the *Origin of Technology*, M. Espinas, after giving numerous examples drawn from ancient Greek life, says: "All the technical arts of this epoch have the same characters. They are religious, traditional, local. The myths referred to are at first the faithful as well as the symbolic expression of them." This mythological symbolism is "the product of a psychological and sociological projection, that is to say, the things of art are conceived as benevolent or angered feelings, as intelligent inventions or combinations that are attributed to fictitious idealised men, as exchanges that are made with them, as gifts or precepts that are received from them, or as orders imposed by their will. They are thus psychical operations or social products drawn from human consciousness unknown to it which, personified, find themselves invoked by it in order to explain to itself its own creations."

The unpublished matter referring to the manuscripts of Descartes is contained in a copy of the 1659 edition of the *Principes* of the French philosopher, and consists of numerous notes in the handwriting of its former owner Joseph de Beaumont. (Paris: Félix Alcan.)

REVUE PHILOSOPHIQUE. No. 178. October, 1890.

CONTENTS:

- LE DELIT POLITIQUE. By G. Tarde.
 UNE NOUVELLE THEORIE DE LA LIBERTE. By A. Belot.
 NOTE SUR LA PHYSIOLOGIE DE L'ATTENTION. By Ch. Féré.
 LES BASES EXPERIMENTALES DE LA GEOMETRIE. By Jules Andrade.
 NOTE SUR LE PRINCIPE DE LA CAUSALITE. By J.-J. Gourd.
 ANALYSES ET COMPTES RENDUS.
 REVUE DES PERIODIQUES ETRANGERS.

M. Tarde finds M. Lombroso too severe and at the same time too kind towards the spirit of conservatism. Too severe in terming it misoneism and too kind in regarding it as the only normal condition of societies. The hospitable reception given to novelties is an equally normal function, although intermittent. If instead of making all his sociological ideas circle round the idea of the *new*, and creating an unfruitful antithesis between the love and the hatred of novelty, he had taken as his central notion the idea of imitation, and proved the universal distinction between the imitation of the new and the imitation of the old, M. Lombroso would have escaped many errors. In all of us, caprice exists by the side of habit, due to physiological misoneism; and the conflict between them goes on in each individual throughout our life. Caprice triumphs at the commencement, but the contest is terminated in old age by the definite victory of habit. It is the same in the social life. The inclination to adopt new ideas is due to the law of imitation, which is a more important factor in great social movements than misoneism.

M. Belot remarks that he would not dare to write the title *Une théorie nouvelle de la liberté* if it referred to a theory of his own. Under it he criticises the theory advanced by M. Bergson in his *Essai sur les données immédiates de la conscience*; according to which freedom belongs, not to the empirical personality of the superficial ego, but to the deeper ego, the subjectivity itself, the alteration of which through the laws of thought and exigencies of science gives rise to the former. According to M. Belot, on the contrary, the will and freedom are shown in the forcing back of the lower ego, which comes to the surface, and its impulses by enlightened ideas. To act in harmony with these is freedom, which is not inconsistent with determinism in the proper sense. Determinism becomes freedom in becoming intelligent. Until then we obey concealed impulses, which may belong to our parents, our ancestors, or our social surroundings, and therefore we are not free.

By an excellent series of experiments, M. Féré has demonstrated that in attention all the qualities of movement are modified; its rapidity, its energy, and its precision, the physiological condition of the process being a general tension of the muscles. It is an error to suppose the intervention of arrestive action, of inhibition, in the physiology of attention. Voluntary immobility results from very intense muscular activities, and has for its physiological condition the general tension of the muscular system, which places the subject in such a condition that he can react in the quickest and most energetic manner possible to an excitation from whatever point it may come. This is the physiological condition of attention. The exercise of immobility is the most favorable to the development of intelligence, while the relaxation of the muscles which results from the removal of the tension tends to the suppression of attention, and of the psychical activity. Excitations of the skin determine exaggerated reflex activities, more rapid and more energetic

movements. As intelligence is developed, the reflex movements become less imperative, the multiplicity of motives of action gives the illusion of freedom of choice. When the excitable centres are incompletely developed, as with women and children, and especially with degenerates, the impulsions and the reflex activities generally, of which the centres are better developed, are more violent and more uncontrollable. (Paris: Félix Alcan).

ZEITSCHRIFT FÜR PSYCHOLOGIE UND PHYSIOLOGIE DER SINNESORGANE. Vol. I. Nos. 4 and 5.

CONTENTS:

UEBER DAS ERKENNEN DER SCHALLRICHTUNG. By *J. v. Kries*.

ZUR PSYCHOLOGIE DER KAUSALITÄT. By *Th. Lipps*.

ZUR INTERAUREALEN LOKALISATION DIOTISCHER WAHRNEHMUNGEN. By *Karl L. Schaefer*.

ZUR PSYCHOLOGIE DER FRAGE. By *Rich. Wahle*.

UEBER NEGATIVE EMPFINDUNGSWERTE (I). By *H. Ebbinghaus*.

VERSAMMLUNGEN: Internationaler medizinischer Kongress zu Berlin 1890. I.

Sektion für Augenheilkunde. Referiert von *Claude du Bois-Reymond*.—II.

Sektion für Ohrenheilkunde. Referiert von *Krakauer*.

LITERATURBERICHT.

Professor J. von Kries examines the hypotheses propounded of late concerning the recognition of the direction in which sound-waves reach the ear. Professor Preyer maintains that different irritations, according to the source of sound, take place in the semi-circular canals, and Münsterberg, on the basis of his own experiments, has with some essential modifications accepted Preyer's views. The author devotes his chief attention to the localisation of sounds originating either to the right or to the left of the median plane. The experiments were made with two movable whistles, the intensity of which could easily be regulated. The result was that concerning right and left direction, and also with regard to simultaneous sounds from both directions at a different pitch, each note could be correctly localised. He adds that, so far as he can judge, even he who adopts Münsterberg's view has to fall back upon a comparison of the intensity in both ears. A localisation of whistle-sounds in the median line, be it in front or at the back, was not so certain. A single tone was, upon the whole, correctly localised; yet it was difficult to discriminate two sounds in the median plane.

In another article on the same subject, entitled *On Interaural Localisation of Diotic Sensations* Karl L. Schaefer of Jena recapitulates in brief the monotic and diotic experiments made by Silvanus B. Thompson, Purkyněs, Urbantschijsch, and Preyer; completing the inquiries of Fechner on the subject he states the following result: "Let two tuning forks be placed at an equal distance from the median plane in front of the ears, so that their sound is medianly localised: 1) Synchronal vibrations of any pitch, at the same distance, and in exactly opposite directions, produce median oscillations; 2) If the forks are moved *a tempo* to the right or to the left, i. e. in the same direction, the sound rolls from ear to ear, so long as the motions are not too rapid; 3) If they are executed as quickly as possible the vibrations have their seats in both ears.

The Psychology of Causality is the subject of a longer article (47 pages) by Prof. Th. Lipps. Lipps declares that his "investigation intends to reduce causality

to association, and the law of causality to the law of association." The author does not identify his undertaking with the psychology of association, and protests against considering mind-activity as passive processes. He devotes almost too much space to stating what is, or can easily become, an anthropomorphic conception of causation. Where he propounds his positive views, we miss discriminative exactness. *Ursache* and *Grund* are not sufficiently distinguished, and the definitions of formal and material cognitions, are not lucidly stated. Dr. Lipps says: "All cognition is objectively conditioned representation; respectively associations of representations. In purely formal cognition the objective *raison d'être* (*Grund*) consists in the presence of a contents of consciousness. In material cognition, or cognition by experience in the narrower sense, it consists in the consciousness of the objective reality of a contents of consciousness."* The author's conclusion is summarised as follows:

"Hume's work and his mistake can thus plainly be recognised. That causal connection is a connection among our ideas, not a connection among the objects represented, that the necessity which distinguishes this connection consists in the psychological compulsion to combine one fact with another, that this compulsion has its reason in association, is the discovery of Hume; and this discovery of Hume is one of the most important in the history of philosophy. That the world becomes a world regulated by law, by being subjected to the law of our mind, this anthropocentric standpoint was therewith determined. Hume's mistake consisted only in this: He did not recognise the full importance of the law of association. Therefore he did not see what associative relations are directly identical with the causal relation. An attempt was made to cover the defect rising therefrom by the principle of habit. Not the principle of association, but the principle of habit depriving the principle of association of its strength, hindered Hume from proposing the correct answer to the question, 'How in experience are general and necessary judgments possible?'" Professor Lipps does not answer this question satisfactorily either; he gives no explanation of the fact that in experience general and necessary judgments are possible. He simply states the fact. Every natural scientist, he says, expects that a certain result that has been observed once, will always take place again if the experiment be repeated under exactly the same conditions.

Professor Lipps states, in concluding, that he is fully conscious of having discussed only a small part of that which might be said on this subject, and adds: "Perhaps objections or criticisms will give me an occasion for additional remarks." We here call his attention to the treatment of the subject in Dr. Paul Carus's pamphlet *Ursache, Grund und Zweck* (Dresden: Grumbkow, 1881) and also to his articles on Form and Formal Thought and on Causality in *Fundamental Problems*.

Dr. Richard Wahle, Privat-docent in Vienna, defines in a short sketch on *The Psychology of the Question* the meaning of Question in the following way: a question is "the preparation during a state of indecision for a perception of the decision." In explaining the meaning of this decision Richard Wahle makes an occasional fling at that kind of psychology which divorced from physiology confines itself to the method of introspection.

* The passage being so difficult to translate, we quote the original in full: "Alle Erkenntniss ist objectiv begründetes Vorstellen, bezw. Verbinden von Vorstellungen. Bei der lediglich formalen Erkenntniss besteht der objective Grund im Dasein eines Bewusstseinsinhaltes, bei der materialen oder Erfahrungserkenntniss im engeren Sinne besteht er im Bewusstsein der objectiven Wirklichkeit eines Bewusstseinsinhaltes."

The last article, by Prof. H. Ebbinghaus, is the first part of a criticism of Fechner's posthumous letters on *Negative Empfindungs werthe*, published in the first numbers of this periodical. These letters, Ebbinghaus declares, afford an interesting insight into the scientific personality of Fechner; yet the doctrine contained therein, he adds, has its drawbacks. Ebbinghaus does not accept Fechner's presentation of the case, but refers us to Delbœuf from whose experiments alone, he says, the correct interpretation of negative values of sensations can be derived. Delbœuf's views are not so clearly presented in his first statement as in a later article written in answer to the objections of Tannery, published in the *Revue Philosophique* V. 1878, and republished under the title *Examen critique de la loi psychophysique* (Paris, 1883). Ebbinghaus adopts Langer's definition of negative values of sensations. They are "such as under all circumstances if additively connected with equally great positive ones produce as a result zero."

The reports of the proceedings of the International Congress of Physicians, Berlin, 1890, will be of special value to physicians. The present number contains those of the sections of oculists and aurists.

The number contains a valuable bibliographical catalogue of the chief works on physiological psychology for the year 1889. (Hamburg and Leipsic: L. Voss.)

PHILOSOPHISCHE MONATSHEFTE. Vol. XXVII. Nos. 1 and 2.

CONTENTS:

QUANTITAET UND QUALITAET IN BEGRIFF, URTHEIL UND GEGENSTAENDLICHER ERKENNTNISS. By *Paul Natorp*.

ZUM BEGRIFF DES NAIVEN REALISMUS. By *E. von Hartmann*.

BEMERKUNGEN ZU VORSTEHENDEM AUFSATZ. By *A. Döring*.

RECENSIONEN.

LITTERATURBERICHT.

Professor Paul Natorp, the editor, discusses Quantity and Quality in Concept, Judgment, and Objective Cognition. His object is the attempt not to proceed subjectively, or psychologically, or genetically, or causally, or teleologically, but purely objectively in the same sense as mathematics proceeds objectively. The result which he reaches is summarily expressed in the statement "that there is no formal logic . . . and that it cannot exist at all—except it be based upon the logic of objective cognition (transcendental logic), or represents a part thereof, the severance of which from the whole to which it belongs can have merely technical not scientific reasons." (Heidelberg: Georg Weiss.)

RIVISTA ITALIANA DI FILOSOFIA. September and October, 1890.

CONTENTS:

DELLA PERCEZIONE DEL CORPO UMANO. By *L. Pietrobono*.

LE IDEE PEDAGOGICHE DI PIETRO CERETTI.

DELL' ATTENZIONE. By *V. Benini*.

LA SCUOLA E LA FILOSOFIA PITAGORICHE. By *S. Ferrari*.

BIBLIOGRAFIA.

BOLLETTINO PEDAGOGICO E FILOSOFICO.

NOTIZIE.

RECENTI PUBBLICAZIONI.

RIVISTA ITALIANA DI FILOSOFIA. November and December, 1890.

CONTENTS:

IL PRESENTE DELLA STORIA DELLA FILOSOFIA. By *L. Credaro*.

LA PEDAGOGIA DI JACOPO SADOLETO. By *A. Piazzi*.

DELLA PERCEZIONE DEL CORPO UMANO. By *L. Pietrobono*.

BIBLIOGRAFIA, etc.

There are two problems which at present command a general and a keen interest in all countries; viz. the psychological problem and the ethical problem, the latter comprising all the questions of education and instruction, religious as well as secular. If this is true of Germany, France, England, and the United States, it is no less true of Italy. The *Rivista Italiana di Filosofia*, so ably edited by Luigi Ferri, Professor at the University of Rome, shows this tendency in its latest numbers in a marked degree. They contain among other valuable materials an article by Luigi Pietrobono on the perception of the human body, a psycho-physiological investigation of sentient substance with special reference to sensation and perception. The author arrives at a result, which, if it could be sustained, would lead to an outspoken dualism. Pietrobono believes in two principles, a psychical and an organical, forming an original synthesis and antithesis, interdependent upon and inseparable from each other. Vittorio Benini discusses in the same number the captivating subject of Attention, starting from a discussion of Ribot's monograph on the subject, and devoting his main interest to what he calls "l'attenzione percettiva è accompagnata dall' intelligenza." The latter kind of attention is of especial importance in education, a subject which is discussed in the conclusion of the article. This leads us to another essay which treats of an exclusively educational subject, proposing the pedagogical ideas of Pietro Ceretti. This article does not contain new truths, but emphasises truths which have perhaps been too little recognised in Italy. Starting from the maxim that all education must develop the faculties of body, soul, and mind (le facoltà del corpo, dell' anima e della mente), and that all education must be conducted so as to let the social body derive the benefits therefrom, he urges besides demanding the moral and intellectual culture of man a technical instruction, and among the sciences, literature, and history, he would give mathematics a prominent place.

It may be added that the department of Bibliography contains among other reviews discussions of the following works: 1) Reich's book on Gian Vincenzo Gravina as an author of aesthetics; 2) Antonio Rosmini's Fragments of a Philosophy of Law and Politics; 3) Robert Benzoni's The Philosophy of Our Day; 4) Pietro Ellero's The Social Question; 5), in the December number, Ferdinando Puglia's Evolution in the History of Italian Philosophical Systems; 6) The national edition of Galileo Galilei's works; and 7) La Somiglianza nella Scuola Positivista e l'Identità nella Metafisica Nuova, by Donato Jaia.

VOPROSY FILOSOFI I PSICHOLOGUII.* Vol. I. No. 4.

CONTENTS:

(PART I.)

REMARKS. By the Editor, *Prof. N. Grote*.

THE POLITICAL IDEALS OF PLATO AND OF ARISTOTLE IN THEIR UNIVERSAL HISTORICAL SIGNIFICANCE. By *Prince E. N. Trubetskoi*.

* *Questions of Philosophy and Psychology.* In the Russian language.

- THE RELATIONS OF VOLTAIRE TO ROUSSEAU. (Conclusion.) By *E. Radlow*
 THE ETHICAL DOCTRINE OF KANT. By *L. Lopatine*.
 HYPNOTISM IN PEDAGOGY. By *A. Tokarsky*.
 CONCERNING THE QUESTION OF FREEWILL FROM THE POINT OF VIEW OF HISTORICAL PROCESS. By *N. Karyew*.
 THE VITAL PROBLEMS OF PSYCHOLOGY. By *N. Grote*.
 NECROLOGY. M. I. Vladislavlew, Rector of the University of St. Petersburg
 By *K*.

(PART II.)

- EXPERIMENTAL PSYCHOLOGY: The Elements of Will. By *N. Lange*.
 CRITIQUE AND BIBLIOGRAPHY.
 COMMON CHARACTERISTICS. Concerning the conflict with the Occident in connection with the literary activity of a Slavophil. By *V. Rotzanow*. The ethical doctrine of Count Tolstoi and its most recent criticism. By *P. E. Astafiew*.
 BOOK REVIEWS. Reviews of Russian philosophical works on Metaphysics, Logic, Psychology, Ethics, and Aesthetics. Reviews of foreign philosophical periodicals. Philosophical articles in Russian ecclesiastical periodicals.
 MATERIALS FOR THE HISTORY OF PHILOSOPHY IN RUSSIA. (1855-1888).
 TRANSACTIONS OF THE MOSCOW PSYCHOLOGICAL SOCIETY.

The distinguished Editor, Prof. N. Grote, in his introductory remarks calls attention to the fact that the present issue of this philosophical and literary review in the Russian language, completes the series that had been promised during the first year of its existence. The review does not claim, during this brief lapse of time, to have been able to solve all the many problems incident to the task that it had assumed at the outset of its career; but it may at least modestly claim to have won the hearty sympathy of an intelligent fraction of the Russian people, expressed by the acquisition of a comparatively large number of subscribers. This material success, moreover, attests the fact that the editor did not deceive himself when at the original publication of the review he seemed to notice an awakening in his country of more serious intellectual interests, and the rise of a desire for a philosophical analysis of the principles of knowledge and of life.

On the other hand, with regard to whether the problems treated of in the pages of the review are identical with those that occupy by preference the minds of intelligent Russian readers; or whether the exposition and the methods of investigation have been properly adjusted to the degree of development and to the mental calibre of the mass of its readers, it will suffice to remark, says the editor, that the full development of all the potential forces of nature and of mind can be attained only through slow and persistent action. We have to bear in mind that the attempt is by no means easy to organise for the first time in a project of this kind the many active workers of a country in which people had never before been associated in a similar undertaking. Yet in confidently entering upon the publication of this review, the editor well knew that there existed in Russia abundant intellectual powers, perfectly adequate to the demands of a high-class philosophical magazine—scientists, learned specialists, talented thinkers, and men of letters; and the review without doubt will not fail to enlist the valuable assistance of all these men in the arduous task, which it will continue steadily to pursue. The main task above all, is to advance the development of *self-consciousness* in modern Russian society, but the success of this aspiration depends of necessity on the continued sympathy and good will of the public.

As regards the external form of the review, for the greater convenience of the public, instead of four volumes of 20 sheets, as hitherto, there will be issued during the present year five volumes in all—one volume of 15-16 sheets bimonthly, except during the midsummer months.

The editor in conclusion expresses his acknowledgment to several of his western colleagues, to the editors of *Mind*, the *Revue Philosophique*, the *Archiv für Geschichte der Philosophie*, and *The Open Court*—all of whom have promised to note with genuine interest the contents of the Russian review "Questions of Philosophy and of Psychology." (Moscow, 1890.)